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UPPER JORDAN RIVER FLOOD CONTROL PROJECT

COMMUNICATION

FROM

THE ACTING PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR CIVIL WORKS, THE DEPARTMENT OF THE ARMY

TRANSMITTING

A REPORT FROM THE CHIEF OF ENGINEERS, WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON THE FLOOD CONTROL PROJECT FOR THE UPPER RIVER JORDAN, SALT LAKE CITY, UT, PURSUANT TO PUBLIC LAW 101-640

APRIL 29, 1991.—Referred to the Committee on Public Works and Transportation and ordered to be printed with illustrations

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

REPLY TO
ATTENTION OF

17 APR 1991

Honorable Thomas S. Foley
Speaker of the House
  of Representatives
Washington, D. C. 20515

Dear Mr. Speaker:

Section 101(a) of the Water Resources Development Act of 1990 authorized a flood control project for the Upper Jordan River, Salt Lake County, Utah. The Secretary of the Army supports the authorization and plans to implement the project through the normal budget process.

The project for Mill Creek, a tributary to the Jordan River, is described in the enclosed report dated November 16, 1988, from the Chief of Engineers. The reports of the Board of Engineers for Rivers and Harbors and district and division engineers are also provided. These reports were prepared under the authority of Section 6 of the Flood Control Act of 1938. Preconstruction engineering and design activities for the project will be continued under the authority provided by the Act.

The views of the State of Utah, and the Departments of Interior and Transportation, are set forth in the report. The State supports the project and the Federal agencies do not object to implementation.

The authorized plan is the national economic development plan and provides for the diversion of floodflows from Mill Creek to a local storm drainage system known as I-9 Ditch. The plan includes a 1.4-mile-long underground conduit from a diversion structure on Mill Creek to the Hillview Detention Basin on I-9 Ditch. The Hillview Detention Basin, a 26-acre-foot structure to be constructed by non-Federal interests as part of a separate storm drainage project, would be enlarged to about 100-acre-feet to store the floodwaters. The project would provide almost an 80-year level of protection. Based on October 1989 price levels, the estimated first cost of the improvements is $7,900,000, of which $5,200,000 would be Federal.

The water resources needs of other areas in the Upper Jordan River Basin were also investigated as part of the study. Those streams were Big Cottonwood Creek, Little Cottonwood Creek, and a 25-mile reach of the Jordan River. The primary needs were for flood control. The studies determined that improvements built by local interests, in response to floods of 1982, 1983, and 1984, significantly reduced flood damages along those streams. Further Federal improvements are not recommended.

Implementation of the project will be subject to cost sharing, financing, and other requirements of law as described in paragraphs 20 and 22 of the report of the Board of Engineers for Rivers and Harbors.

Implementation will be subject to the recommended local cooperation item 20c being replaced with the following provision that the non-Federal sponsor provide:

> "c. All necessary alterations and relocations of buildings, transportation facilities, and utilities including storm drains and sanitary sewers, and other structures and improvements made necessary by construction, operation, and maintenance of the project;"

Implementation will be further subject to the addition of local cooperation item 22f on page 8 which addresses non-Federal responsibilities for hazardous materials. Specifically that the non-Federal sponsor:

> "f. Assume complete financial responsibility for the cleanup of any hazardous materials located on project lands and regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and be responsible for operating, maintaining, repairing, replacing, and rehabilitating the project in a manner so that liability will not arise under CERCLA."

The Office of Management and Budget advises that there is no objection to the submission of the report to the Congress. A copy of its letter is enclosed in the report.

Sincerely,

G. Edward Dickey
Acting Principal Deputy
Assistant Secretary (Civil Works)

Enclosure

COMMENTS OF THE OFFICE OF MANAGEMENT AND BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

October 26, 1990

Dr. G. Edward Dickey
Acting Assistant Secretary
of the Army (Civil Works)
Room 2E570 - Pentagon
Washington, DC 20310-0108

Dear Dr. Dickey:

As required by Executive Order 12322, we have completed our review of your office's recommendation and the report on Upper Jordan River, Utah, enclosed in letter dated February 7, 1990.

The Office of Management and Budget does not object to your submitting this report to Congress. The recommendation is consistent with the program of the President, contingent upon project authorization and funding in accordance with the cost-sharing provisions of P.L. 99-662.

Sincerely,

RGrady

Robert E. Grady
Associate Director
for Natural Resources,
Energy and Science

COMMENTS OF THE GOVERNOR OF UTAH

STATE OF UTAH
OFFICE OF THE GOVERNOR
SALT LAKE CITY
84114

NORMAN H. BANGERTER
GOVERNOR

August 26, 1988

John M. McCann, Jr.
Acting Resident Member
Board of Engineers for Rivers and Harbors
Department of the Army
Kingman Building
Fort Belvoir, Virginia 22060-5576

Dear Mr. McCann:

In regard to the Feasibility Report and Environmental Impact Statement concerning the Upper Jordan River Interim Investigation, dealing specifically with flood control features on Mill Creek in Salt Lake Valley, I offer the following comments:

As you realize, flood control is a county option; therefore, your continued contact and cooperation with Salt Lake County Flood Control is essential. The State of Utah does have some concerns, and it appears as though they are adequately covered. However, I think they are worthy of mention. Many residents of the state were impacted during 1983-1984 by high flows. This type of project would prove beneficial to individuals living adjacent to the stream channel. These residents, however, have become accustomed to enjoying the environment created by a natural channel, and I would urge close cooperation with Utah Division of Wildlife Resources in restoring these channels if they are disrupted by construction. There are also water right holders along the various reaches of Mill Creek. The activities involved with flood control should in no way affect the ability of these individuals to divert, control and beneficially use the waters of Mill Creek.

I thank you for the opportunity of commenting.

Sincerely,

Norman H. Bangerter

Norman H. Bangerter
Governor

LETTER TO THE GOVERNOR OF UTAH

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-PW

16 November 1988

Honorable Norman H. Bangerter
Governor of Utah
Salt Lake City, Utah 84114

Dear Governor Bangerter:

Thank you for your letter of August 26, 1988, supporting the Upper Jordan River Interim Investigation and proposed flood control features on Mill Creek in Salt Lake valley.

Your letter urged close cooperation with the Utah Division of Wildlife Resources in restoring channels disturbed by the proposed project construction. In addition, your letter stated that the flood control project should not interfere with existing water rights on Mill Creek. Please be assured, that the Army Corps of Engineers, Sacramento District, will work closely with the Utah Division of Wildlife Resources to accomplish complete and effective restoration of all channels disturbed by the proposed project. Further, we will coordinate the proposed flood control project design and construction with the State Engineer's Office and Salt Lake County to ensure that there is no interference with existing water rights on Mill Creek.

Sincerely,

H. J. Hatch
Lieutenant General, U. S. Army
Commanding

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

United States Department of the Interior
OFFICE OF ENVIRONMENTAL PROJECT REVIEW
WASHINGTON, D.C. 20240

ER 88/414

AUG 5 1988

Lieutenant General H. J. Hatch
Chief of Engineers
ATTN: CECW-P
Department of the Army
Washington, D.C. 20314-1000

Dear General Hatch:

Thank you for the letter of May 12, 1988, requesting our views and comments on the proposed report of the Chief of Engineers, other pertinent reports, and final environmental impact statement for the Upper Jordan River, Utah.

We concur in the findings of the proposed report and forsee no conflicts with the programs or missions of this Department.

Sincerely,

Bruce Blanchard, Director

COMMENTS OF THE DEPARTMENT OF TRANSPORTATION

U.S. Department
of Transportation
**United States
Coast Guard**

Commandant
United States Coast Guard

Washington, D.C. 20593-0001
Staff Symbol: (G-MP-1)
Phone: (202) 267-0389

File 16/3124J

19 MAY 1988

Chief of Engineers
Attn: CECW-P
Department of the Army
Washington, D. C. 20314-1000

Dear Chief of Engineers:

We have reviewed the proposed report of the Chief of Engineers on Upper Jordan River, Utah, other pertinent reports, and Final Environmental Impact Statement and have no comments to offer.

Thank you for providing us the opportunity to review the proposed report and FEIS on Upper Jordan River, Utah.

Sincerely,

M J Schiro
M. J. SCHIRO
Captain, U. S. Coast Guard
Chief, Planning Staff
By direction of the Commandant

UPPER JORDAN RIVER, UTAH

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:
CECW-PM (10-1-7A) November 16, 1988

SUBJECT: Upper Jordan River, Utah

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on Upper Jordan River, Utah. It is accompanied by the reports of the Board of Engineers for Rivers and Harbors and the district and division engineers. These reports are in partial response to Section 6 of the Flood Control Act of 1938 (Public Law 761, 75th Congress) which authorized preliminary examinations and surveys for flood control at a number of locations and streams, including streams draining into the Great Salt Lake and the Great Basin, Utah and Nevada. A final report in full response to the flood control act will be submitted at a later date.

2. The district and division engineers recommend that a flood damage reduction plan for Mill Creek, Salt Lake County, Utah, be authorized for implementation as a Federal project. The plan provides for diverting floodflows from Mill Creek to a local storm drainage system known as I-9 Ditch. The plan includes a 1.4-mile-long conduit from a diversion structure on Mill Creek to the Hillview Detention Basin on I-9 Ditch. The Hillview Detention Basin, to be constructed by Salt Lake County as part of a separate storm drainage project, would be enlarged to store floodwaters diverted from Mill Creek. The plan would provide almost an 80-year-frequency level of flood protection in some reaches. It would have minor adverse environmental impacts. Mitigation for lost vegetation and wildlife habitat would be accomplished through revegetation of project lands. Separate fish and wildlife mitigation measures would not be needed. The recommended plan maximizes net national economic development benefits.

3. The Board of Engineers for Rivers and Harbors concurs in the views and recommendations of the reporting officers. The board finds that the proposed improvements are economically justified, technically sound, and environmentally acceptable. Based on October 1988 prices, the first cost of the recommended plan is $7,620,000 of which $5,020,000 would be Federal and $2,600,000 would be non-Federal under cost sharing provisions of the Water

Resources Development Act of 1986, Public Law 99-662. Average annual costs based on an interest rate of 8-7/8 percent and a 100-year period for economic analysis are $700,000 including $20,000 for annual operation and maintenance. Average annual benefits are estimated at $966,000 and the benefit-cost ratio is 1.4.

4. I concur in the findings, conclusions, and recommendations of the board.

5. The recommendations contained herein reflect policies governing formulation of individual projects and information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the local and State programs or the formulation of a national civil works construction program. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation finding. However, prior to transmittal to the Congress, the sponsor, the State(s), interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

H. J. HATCH
Lieutenant General, USA
Chief of Engineers

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

DEPARTMENT OF THE ARMY
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
KINGMAN BUILDING
FORT BELVOIR, VIRGINIA 22060-5576

REPLY TO
ATTENTION OF:
CEBRH-PL (10-1-7a) 9 May 1988

SUBJECT: Upper Jordan River, Utah

Chief of Engineers
Department of the Army
Washington, DC 20314-1000

SUMMARY OF BOARD ACTION

The board finds that improvements for flood control along Mill Creek, Salt Lake County, Utah, are economically justified and environmentally and socially acceptable. The recommended plan would divert floodflows from Mill Creek to a local storm drainage system known as I-9 Ditch. The plan provides for a 1.4-mile-long underground conduit from a diversion structure on Mill Creek to the Hillview Detention Basin on I-9 Ditch. The Hillview Detention Basin, to be constructed by local interests as part of a separate storm drainage project, would be enlarged to store the floodwaters diverted from Mill Creek. Mitigation for lost vegetation and wildlife habitat would be accomplished through revegetation of project lands. The plan would provide almost an 80-year-frequency level of protection in some areas and would reduce average annual flood damages by about 68 percent. Based on October 1987 prices, the estimated first cost of the recommended plan is $7,360,000 and the benefit-cost ratio is 1.4.

1. AUTHORITY. This interim report is in response to section 6 of the Flood Control Act of 1938 (Public Law 761, 75th Cong.) which authorized preliminary examinations and surveys for flood control at a number of locations and streams, including streams draining into the Great Salt Lake and the Great Basin, Utah and Nevada. The pertinent part of the act is quoted in the district engineer's report. A final report in full response to the Flood Control Act of 1938 will be submitted later.

2. DESCRIPTION OF THE STUDY AREA. The study area is in north-central Utah, south of Salt Lake City. The drainage area encompasses the western slopes of the Wasatch Mountains and a 25-mile reach of the Jordan River extending from the Jordan Narrows downstream of Lake Utah to the southern limits of Salt Lake City. The total drainage area is about 420 square miles. Topography is characterized by high rugged mountains, deep canyons, and a relatively flat valley floor. Valley elevations range from about 4,200 feet above sea level near the Great Salt

Lake to about 5,200 feet on the terraces at the base of the Wasatch Mountains. The mountains rise to elevations of over 11,000 feet.

3. The principal streams in the area are Big Cottonwood Creek, Little Cottonwood Creek, and Mill Creek. These streams drain 77, 40, and 35 square miles, respectively, and are located entirely in Salt Lake County. The Mill Creek drainage area is almost completely developed, while drainage areas of the Big and Little Cottonwood Creeks are only partially developed.

4. Due to urbanization, the valley flatlands have limited fish and wildlife resources. Vegetation along streams is primarily ornamental with some cottonwoods, willows, and other small woody species. Fish populations are limited due to poor water quality, little shading, and lack of water during winter months. Terrestrial wildlife consists mostly of songbirds. Although most of the streams are used for municipal, industrial, and irrigation purposes, water quality is good only in headwater areas. In the Jordan River and in the lower reaches of its tributaries water quality is satisfactory for irrigation and some industrial uses but is unacceptable for municipal and certain manufacturing purposes and for water contact recreation.

5. ECONOMIC DEVELOPMENT. Early economic development centered around agriculture and processing of agricultural products. While agriculture is still important to the economy, the region has developed as an urban center with a broad commercial and industrial base. The primary industrial activities are mining and refining of metals, production of steel and chemical products, and manufacturing. In 1986, the population of Salt Lake County was approximately 700,000 persons, accounting for about 44 percent of the State's population of about 1.6 million. Salt Lake County is expected to continue to grow, reaching a population of about 800,000 persons by 1993, and 900,000 by the year 2000.

6. EXISTING AND AUTHORIZED IMPROVEMENTS. The only U.S. Army Corps of Engineers (USACE) project in the immediate area is a channel improvement and levee project along the Jordan River near Salt Lake City. Local interests constructed numerous flood control and storm drainage projects along Big Cottonwood, Little Cottonwood, and Mill Creeks in the mid-1980's. Those projects which consist of channel improvements, bridge and culvert replacements and modifications, and detention basins have greatly reduced flood damages along those streams.

7. PROBLEMS AND NEEDS. Due to the beneficial effects of the USACE Jordan River project and improvements constructed by local interests on tributary streams, the only significant remaining

water resources problem in the study area is flooding along Mill Creek. Problem areas along Mill Creek are downstream of Highland Drive, where channel capacity is limited and overbank flooding occurs as frequently as once every 3 to 5 years. Approximately 2,665 acres of land and about 2,900 structures, including 2,470 residences, are located in the 500-year-frequency floodplain. Those structures and their contents have a combined value of about $615.5 million (October 1986 prices and 1984 level of development). Flooding occurs both from snowmelt and rainfall runoff. Recent floods include the September 1982 rainfall flood and the 1983 and 1984 snowmelt events. Average annual damages to existing developments are estimated at $1,123,000, while equivalent average annual damages, taking into account future increases in the number of structures and runoff, are estimated at $1,311,000 (October 1986 prices). Almost all of these damages are the result of rainfall runoff and not snowmelt flooding.

8. IMPROVEMENTS DESIRED. Local interests desire assistance in reducing the remaining flood problems along Mill Creek.

9. ALTERNATIVES CONSIDERED. A variety of structural and nonstructural measures were considered. Nonstructural alternatives included permanent and temporary evacuation of floodprone areas and floodproofing. Structural measures included bridge and culvert replacements, upstream reservoirs, channelization, diversion and offstream storage of floodwaters, and a combination of diversion and offstream storage and channelization. Diversion plans were found to be the most cost effective solutions, and diversion of 250-, 500-, 750-, and 1,000-cubic-foot-per-second (cfs) discharges were evaluated.

10. PLAN OF IMPROVEMENT. The plan proposed by the district engineer would divert floodwaters from Mill Creek through a 1.4-mile-long conduit to the Hillview Detention Basin located on I-9 Ditch. The Hillview Basin, planned for construction by local interests in the early 1990's, would be enlarged to contain the floodwaters. Following a flood, water would be released from the basin into the I-9 Ditch where it would flow into the Big Cottonwood Creek and then into the Jordan River. Elements of the proposed project are as follows:

a. A diversion structure would be constructed on Mill Creek just upstream of Highland Drive. It would be designed to pass flows up to 200 cfs directly to Mill Creek and to bypass discharges up to 750 cfs via a conduit to the Hillview Detention Basin. Flows into the conduit would be controlled by automatic sluice gates.

b. Salt Lake County's proposed Hillview Detention Basin would be enlarged for temporary storage of floodwaters diverted from Mill Creek. The size of the basin would be increased from about 26 acre-feet to about 100 acre-feet by raising and extending the structure's embankments and levees and excavating a portion of the basin.

c. A 1.4-mile-long, 84-inch-diameter reinforced concrete pipe would connect the diversion structure with the enlarged Hillview Detention Basin. The pipe would be sized to carry flows up to 750 cfs. The alignment would follow existing streets and the conduit would outlet into an energy dissipator at the basin.

d. Adverse environmental impacts associated with the loss of vegetation and wildlife habitat would be mitigated by landscape plantings at the diversion structure and detention basin.

11. ECONOMIC EVALUATION. Based on October 1986 prices, the district engineer estimates the first cost of the proposed project to be $7,180,000. Federal and non-Federal costs would be $4,660,000 and $2,520,000, respectively, based on cost-sharing and financing requirements of Public Law 99-662. Average annual charges based on an 8 7/8-percent interest rate and a 100-year period for economic analysis are $672,000 including $20,000 for operation and maintenance. Average annual benefits attributable to the project are estimated at $894,000 and the benefit-cost ratio is 1.3. The recommended plan maximizes net national economic development (NED) benefits.

12. PROJECT EFFECTS. The recommended plan would provide almost an 80-year-frequency level of protection in some reaches. Average annual damages would be reduced from about $1,311,000 to $417,000, a reduction of about 68 percent. Protection would directly enhance the welfare and security of people working and living in the area by eliminating frequent water damage and the cost of repeated repairs and replacement of damaged property. The proposed project would have minor adverse environmental impacts. There would be a loss of about 0.3 acre of vegetation due to construction of the diversion structure and a loss of about 1.5 acres of wildlife habitat due to enlargement of the Hillview Detention Basin. These losses would be mitigated through revegetation of project lands. Impacts associated with construction of the pipeline would be short term and limited to traffic disruption, dust, and noise during construction.

13. RECOMMENDATION OF THE REPORTING OFFICERS. The district engineer recommends authorization of a plan for flood protection along Mill Creek, Salt Lake County, Utah, generally in accordance with the plan described in his report. His recommendation is

made subject to certain requirements of local cooperation and subject to cost-sharing, financing, and other requirements of the Water Resources Development Act of 1986. The division engineer concurs.

REVIEW BY THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

14. GENERAL. The board reviewed the overall technical, economic, social, environmental, and policy aspects of the flood control improvements proposed by the reporting officers. The board considered the report's conformance with the essential elements of the Water Resources Council's Principles and Guidelines for Water and Related Land Resources Implementation Studies and other applicable administrative and legislative policies and guidelines. The board also considered the views of interested parties, including Federal, State, and local agencies.

15. RESPONSE TO THE DIVISION ENGINEER'S PUBLIC NOTICE. The division engineer issued a public notice on 25 September 1987 stating the findings and recommendations of the reporting officers and inviting public comment to the board. The board did not receive any letters in response to the notice.

16. FINDINGS AND CONCLUSIONS. The Board of Engineers for Rivers and Harbors concurs in the findings and recommendations of the reporting officers. The recommended diversion and detention basin enlargement are economically justified, engineeringly feasible, and environmentally and socially acceptable. The recommended plan would generally provide flood protection from almost an 80-year-frequency flood event along Mill Creek in Salt Lake County. Improvements would reduce financial losses, health hazards, and risk to human life and safety associated with existing flooding problems.

17. The plan recommended by the reporting officers maximizes net NED benefits. The plan complies with applicable policies and guidelines and stipulated items of local cooperation are appropriate. Separable elements of the plan are incrementally justified and there are no significant adverse environmental impacts. The proposed plan does not require separable fish and wildlife mitigation measures.

18. FEDERAL INTEREST. USACE flood control projects may be considered in reaches where the discharge of the 10-percent flood event exceeds 800 cfs. However, application of this policy is not clear in situations where the discharge of the 10-percent flood first exceeds 800 cfs but then drops below that level in downstream reaches. This is the situation found on Mill Creek. The 10-percent flood discharge first exceeds 800 cfs at Highland Drive but then is less than 800 cfs from the Scott Avenue

Detention Basin downstream to the Jordan River. This condition is due to the regulating effects of Salt Lake County's Scott Avenue and 550 East Street Detention Basins. While no Federal improvements are recommended in these lower reaches of Mill Creek, the board was concerned about whether benefits derived within those reaches could be used to justify the proposed project. The board has been advised by HQUSACE that benefits can be claimed for flood damage prevention for all reaches downstream of the most upstream point where the discharge is greater than 800 cfs for the 10-percent flood. Thus, it is acceptable to justify the proposed project based on benefits derived from all reaches below Highland Drive. Under this condition, the project would be economically justified.

19. HILLVIEW DETENTION BASIN. In formulating the recommended plan, the reporting officers assumed that local interests would construct the 26 acre-foot Hillview and 17 acre-foot Upper Detention Basins and other improvements along I-9 Ditch prior to construction of the proposed Federal project. All costs for the Hillview facility, including over $4 million in land costs, are considered sunk costs in the economic analysis of the proposed Federal project. However, if the Hillview Basin is not constructed by local interests, the proposed Federal project would have to account for the cost of lands and the benefit-cost ratio would be 0.8. In addition, if the Mill Creek diversion project and the local Hillview Basin were to be constructed as a joint flood control and storm drainage project with land and construction costs allocated in proportion to the storage for each purpose, the benefit-cost ratio for flood control would be 0.9. Under both of these conditions, the proposed project would not be economically justified and the board would not recommend its construction.

a. In view of the sensitivity of the foregoing assumption on the economic justification of the proposed Federal project, the board considered the likelihood that local interests will complete that work. Salt Lake County has already acquired lands for the two basins and the designs of these facilities have been completed. The county has a 3 mill tax which raises funds for flood control and storm drainage improvements. Revenues from this tax are about $7.5 million per year. Currently, these funds are being used to pay off a $33.5 million bond for restoration of public facilities and for construction of local flood control and storm drainage improvements following several floods in the early 1980's. The bond should be paid off in 1991 with construction of the planned improvements along I-9 Ditch scheduled for 1992 and 1993.

b. The board concurs with the reporting officers' conclusion that local interests will construct planned improvements along I-9 Ditch in a timely manner. To insure that local interests implement these improvements, the reporting officers have specified an item of local cooperation which requires that local interests construct the facilities as a condition to their recommendation for authorization of the Federal project. The board believes this is a necessary and reasonable requirement.

20. The proposed improvement is a structural project with all costs assigned to flood control. Therefore, in accordance with Public Law 99-662, non-Federal interests would be responsible for the requirements listed below. The non-Federal share of project costs shall not exceed 50 percent of total project costs.

a. A cash payment of 5 percent of the cost of the project to be paid during construction;

b. All lands, easements, and rights-of-way, including suitable borrow and disposal areas, determined to be necessary for construction, operation, and maintenance of the project;

c. All necessary alterations and relocations of buildings, transportation facilities, and utilities including storm drains and sanitary sewers, other than those portions which pass under or through the project's structure, and other structures and improvements made necessary by construction, operation, and maintenance of the project;

d. Additional cash contributions as are necessary so that the total contribution of non-Federal interests is not less than 25 percent of the cost of the project, to be paid during construction;

e. Operating, maintaining, replacing, and rehabilitating the project in accordance with regulations prescribed by the Secretary of the Army;

f. Holding and saving the United States free from damages due to the construction or operation and maintenance of the project, except for damages due to the fault or negligence of the United States or its contractors; and

g. Participating in and complying with applicable Federal floodplain management and flood insurance programs.

21. Based on October 1987 prices, the total first cost of the proposed project is $7,360,000, of which $4,838,000 would be Federal and $2,522,000 would be non-Federal under cost-sharing requirements of Public Law 99-662. Included in the non-Federal amount is the 5 percent cash contribution of $368,000 to be paid during construction of the project. Costs for relocation and

alteration of utilities which pass under or through the proposed project are shared between the Federal Government and the non-Federal sponsor. Average annual charges based on an interest rate of 8 5/8 percent and a 100-year period for economic analysis would be $669,000 including about $20,000 for annual operation, maintenance, and periodic replacements. Average annual benefits are estimated at $929,000, including $817,500 for prevention of existing damages and $111,500 for prevention of future damages. The benefit-cost ratio is 1.4.

22. RECOMMENDATION. The board recommends that flood control improvements along Mill Creek in Salt Lake County, Utah, be authorized for implementation in accordance with the reporting officers' plan, with such modifications as in the discretion of the Chief of Engineers may be advisable. This recommendation is subject to cost-sharing, financing, and other requirements of Public Law 99-662, and as otherwise provided by law, and that non-Federal interests agree to comply with the specific provisions listed below:

a. At least annually, inform affected interests regarding the limitations of the protection afforded by the project;

b. Publicize floodplain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the floodplain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project;

c. Prior to initiation of construction, prescribe and enforce regulations or other floodplain management techniques to prevent obstructions or encroachments which would reduce the flood-carrying or flood-storage capacity of Mill Creek, diversion structure and conduit, Hillview Detention Basin, I-9 Ditch, or Big Cottonwood Creek, or hinder their operation and maintenance; and control development in the project area to prevent undue increases in the flood damage potential;

d. Prior to initiation of construction, accomplish without cost to the United States all currently planned and necessary storm drainage improvements to I-9 Ditch, including construction of the 26-acre-foot Hillview Detention Basin, 17 acre-foot Upper Detention Basin, and other culverts, bridges, and channel modifications designed for flows of 30 cfs; and

e. Operate and maintain the currently planned storm drainage improvements to I-9 Ditch and the carrying capacity of Big Cottonwood Creek in a manner which assures the proper functioning of the proposed Federal project.

23. The recommendations contained herein reflect policies governing formulation of individual projects and information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the local and State programs or the formulation of a national civil works construction program. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State(s), interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

FOR THE BOARD:

GKWithers
GEORGE K. WITHERS, JR.
Major General, USA
Chairman

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

The purpose of this study was to investigate flood and water related problems in a portion of the Jordan River Basin and to determine the need for and feasibility of improvements to solve these problems.

The study area encompasses the western slope drainages of the Wasatch Mountains and bench and valley lands tributary to Mill Creek, Big and Little Cottonwood Creeks, and a 25-mile reach of the Jordan River extending from the Jordan Narrows to 2100 South Street in Salt Lake City. The area was selected for interim investigation because of rapid urbanization and an increasing frequency of flooding and damages.

Initial evaluations were made for each study area stream and included preliminary identification of alternative plans. Due to serious floods in September 1982 and June of 1983 and 1984, local interests implemented measures to mitigate damages, including several measures developed during the preliminary interim investigation. Consequently, the problem area and improvement plans were reassessed, and the final development of plans was limited to Mill Creek.

The selected plan includes flood control features on Mill Creek. These features include a diversion structure located about 200 feet above Highland Drive and a 7,440-foot-long, 84-inch-diameter conduit connecting Mill Creek with an enlarged Hillview Detention Basin. The diversion structure would pass Mill Creek flow up to 200 cfs to the channel and divert up to 750 cfs into the conduit for conveyance to the Hillview Detention Basin for regulation and subsequent release to Big Cottonwood Creek through a storm drainage system. The plan complements local interests measures by providing near 100-year flood protection on Mill Creek above State Street and in reducing erosion, sedimentation, and other adverse effects of floodflows.

It is recommended that, subject to certain conditions of non-Federal cooperation as outlined in this report, the proposed project be authorized for construction. Estimated first cost of the project is $7,180,000. Annual cost is estimated at $672,000, based on an 8-7/8 percent interest rate and a 100-year economic life. Average annual benefits are estimated at $894,000, and the benefit-cost ratio is 1.3 to 1. Cost sharing requirements for the project comply with Section 103 of the Water Resources Development Act of 1986. The Act requires non-Federal interests to pay 5 percent of the cost of the project (currently estimated to be $360,000); to provide all lands, easements, and rights-of-way (currently estimated to cost $490,000); and to perform all related necessary relocations (currently estimated to cost $1,670,000). The total non-Federal first cost would be $2,520,000. Non-Federal interests would also be responsible for operating and maintaining the project. Annual operation and maintenance costs are estimated to be $20,000. The total Federal first cost would be $4,660,000.

REPORT OF THE DISTRICT ENGINEER

UPPER JORDAN RIVER INTERIM INVESTIGATION
UTAH

FEASIBILITY REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

INTRODUCTION

PURPOSE

This feasibility report and environmental impact statement were prepared by the Sacramento District, U.S. Army Corps of Engineers to describe investigations made to determine the need for providing additional flood protection to a portion of the Jordan River Basin approved for interim study.

STUDY AUTHORITY

The basic authorization for this investigation is contained in the Flood Control Act of 1938, which reads in part as follows:

> "Section 6. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control including floods aggravated by or due to the effects at the following named locations ... Streams draining into the Great Salt Lake, and the Great Basin, Utah and Nevada ..."

In October 1960, the Chief of Engineers authorized an investigation of the Jordan River Basin as a separate unit of the Great Basin study. An interim investigation of the Upper Jordan River area was initiated in 1979. This report was prepared as an interim response to the basic authorization contained in the Flood Control Act of 1938 and subsequent discretionary authorities.

SCOPE OF STUDY

The study area, shown on Plate 1, is in the Jordan River Basin of the Great Basin region of Utah. The area encompasses the western slope drainages of the Wasatch Mountains and bench and valley lands tributary to Mill Creek, Big and Little Cottonwood Creeks, and a 25-mile reach of the Jordan River extending from the Jordan Narrows to 2100 South Street in Salt Lake County. The Jordan River, as it flows northward along the Salt Lake Valley floor en route to the Great Salt Lake, intercepts the three westward-flowing tributary creeks (Mill and Big and Little Cottonwood Creeks) and has a total drainage area of 420 square miles between Utah Lake and near 2100 South Street, considered to be the dividing line between the upper and lower Jordan River.

The Upper Jordan River area was selected for interim feasibility investigation on the basis of rapid urbanization of the area and the increasing frequency of flooding and damages.

This investigation concentrated on flood problems in the area but also considered opportunities for water conservation, water quality improvement, recreation, and the preservation and enhancement of environmental values.

The investigation concentrated on identifying flood problems and evaluating possible solutions in sufficient depth to eliminate alternatives which were not viable. Plans were developed from potentially viable alternatives which were economically feasible, environmentally acceptable, and determined to be in the best public interest. Those plans which can best be implemented by local interests were not developed in full detail. Detailed studies were conducted for the plan of improvement for Federal consideration.

THE REPORT

This feasibility report discusses (1) investigations leading to development of the selected plan of improvement, (2) the selected plan, and (3) actions needed for implementation of the plan. The report is arranged into two major segments: the main report and the Environmental Impact Statement (EIS). The Coordination Act Report of the U.S. Fish and Wildlife Service, the endangered species informal consultation response, and a Section 404 (b)(1) evaluation are attached to the EIS.

HISTORY OF THE INVESTIGATION

Comprehensive investigations of flood and related problems in the Jordan River Basin were initiated in 1939 and have been conducted intermittently by the Corps of Engineers since that time. Study of the Jordan River Basin as a separate unit of the overall Great Basin study was approved by the Chief of Engineers in October 1960.

Four interim studies have been completed within the framework of the Jordan River Basin comprehensive authority. These studies resulted in authorization and construction of the Jordan River at Salt Lake City Project (Jordan River and Surplus Canal Improvements), and authorization of the Little Dell Lake Project near Salt Lake City and the Spanish Fork River Channel Improvement Project in Utah County (subsequently deauthorized). A feasibility report outlining transformation of the lower Jordan River into a combination floodway-parkway was completed in May 1976 by the Sacramento District Engineer and adopted as the Division Engineer's report in March 1977. The project was not authorized for construction.

A public meeting was held in August 1977 to identify flood and water related problems in the Jordan River Basin; to allow interested parties to express their views; and to determine the need for future studies in the basin. Subsequently, a reconnaissance assessment of flood and water related problems was conducted, and a reconnaissance report was completed in December 1978. This report recommended an interim investigation of the Upper Jordan River area. In March 1979 the South Pacific Division Engineer approved an interim investigation of the Upper Jordan River area. Studies were then conducted to formulate alternative flood control plans. These plans were presented to the public at two workshops held in June 1982.

Salt Lake City, Utah
Looking southward across Salt Lake Valley
Main Street near center of photo.

Jordan River near 3300 South Street

Mill Creek at 900 West Street, looking toward the Wasatch Mountains (low flow condition).

Big Cottonwood Creek has been retained as a seminatural channel through much of its urban setting.

Little Cottonwood Creek, above 5300 South Street.

Serious floods in the study area in September 1982 and in June of 1983 and 1984 resulted in local interests implementing portions of the proposed plans identified during the initial investigation to mitigate damages. Salt Lake County passed a bond issue on 13 December 1983 for $33.5 million, $11.5 million for restoration work and $22 million for capital improvements, including several measures developed during this interim investigation. Subsequently, residual flood problem areas and improvement plans were reassessed and the plan of improvement redefined.

In May 1987 a plan of improvement for the Upper Jordan area was presented to the public at a public meeting held in South Salt Lake City. The plan of improvement is described herein.

STUDY PARTICIPANTS AND COORDINATION

Several agencies and groups at the Federal, State, and local level participated in the investigation. They include:

Federal Agencies

Fish and Wildlife Service
Federal Emergency Management Agency
Geological Survey
Soil Conservation Service

State Agencies

Provo-Jordan River Parkway Authority
Utah Division of Water Resources
Utah Division of Parks and Recreation
Utah Division of Wildlife Resources
Utah Division of Health, Environmental Health Services Branch
Utah Division of State History
Utah State Planning Coordinator
Utah State Historic Preservation Officer

Salt Lake County Agencies

Planning and Zoning Director
Department of Public Works, Flood Control and Water Quality
  and Water Pollution Control Division
Parks and Recreation Department
Salt Lake County Surveyor

These agencies provided documents, data, and input at various stages of the investigation and participated in public hearings and workshops. The initial public meeting, subsequent public workshops, and numerous meetings with Salt Lake County officials were used to insure that the investigation was coordinated with other activities in the area and would be responsive to public views and preferences.

The U.S. Fish and Wildlife Service conducted independent assessments and evaluations for the study area streams and prepared a Coordination Act Report on the fish and wildlife values and potential project impacts. The Coordination Act Report and input from other environmental sources were used to prepare a final environmental impact statement for the study.

Various public involvement activities were conducted to ensure that the study would be responsive to public views and needs.

PRIOR STUDIES AND REPORTS

Prior studies and reports by the Corps of Engineers and other agencies which are of primary importance to the Upper Jordan River Interim investigation are summarized below.

Corps of Engineers

Transcript of Public Hearing-Review Report on Salt Lake County Streams-Jordan River Basin, Utah. 16 January 1968.

Unpublished-Interim Survey Report for Flood Control on Jordan River Basin-Salt Lake County Streams, Utah. June 1970.

Flood Plain Information-Jordan River Complex-Salt Lake City, Utah. October 1969.

Flood Plain Information-Jordan River Complex II-Midvale-Draper, Utah. March 1974.

Transcript of Public Meeting-Jordan River Basin Investigation, Utah. 9 August 1977.

Reconnaissance Report-Jordan River Basin Investigation, Utah. December 1978.

Jordan River Basin-Environmental Inventory. October 1979. Upper Jordan River Draft Environmental Assessment. October 1980.

Upper Jordan River Interim Investigation, Utah-Stage 2 Technical Data Report. September 1981.

Synopsis of Public Workshop on Development of Flood Control Plans for Mill Creek-Upper Jordan River Interim, Utah. 29 June 1982.

Synopsis of Public Workshop on Development of Flood Control Plans for Big and Little Cottonwood Creeks and the Jordan River-Upper Jordan River Interim, Utah. 30 June 1982.

Jordan River Investigation, Utah-Hydrology Office Report. May 1984 (Revised).

Other Agency Reports

Salt Lake County Water Quality and Pollution Control-Area-Wide Water Quality Management Plan. October 1978.

Salt Lake County Area-Wide Water Study-Metropolitan Water District of SLC, Salt Lake County Water Conservancy District and Salt Lake City Corporation. April 1982.

Flood Insurance Study-City of Salt Lake City, Utah-Salt Lake County-FEMA. February 1983.

Preliminary Flood Damage Assessment For The 1983 Snowmelt Flood in Salt Lake County-Salt Lake County Department of Public Works, Flood Control and Water Quality Division. 20 June 1983.

Summary of Scoping Reports For The Flood Restoration Projects Resulting From 1983 Snowmelt Flood in Salt Lake County-Salt Lake County Department of Public Works, Flood Control and Water Quality Division. 24 October 1983.

Flood Control Feasibility Study for Lower Mill Creek-Salt Lake County Public Works Department, Flood Control and Water Quality Division. January 1984.

AUTHORIZED AND COMPLETED WATER RESOURCES PROJECTS

Authorized Corps of Engineers Projects

Flood control investigations within the Jordan River Basin by the Corps of Engineers that have resulted in Federally authorized projects are shown below.

Flood Control Investigations	Published	Current Status
Spanish Fork River, Utah	HD 518/79/2	Deauthorized.
Jordan River at Salt Lake City and Little Valley Wash at Magna	HD 572/79/2	Jordan River improvements constructed. Little Valley Wash Deauthorized
Jordan River Basin, Salt Lake City Streams, Utah (Little Dell Project)	HD 213/86/1	Authorized
Review Report on Little Dell Lake Project, Salt Lake City Streams, Utah	SD 53/90/1	Authorized

The authorized Little Dell Lake project includes the Little Dell Dam and Lake which will be located on Dell Creek, a tributary of Parleys Creek which is tributary to the Jordan River below 2100 South Street, the lower limit of the upper Jordan River area. The plan of improvement provides for construction of a dam about 8 miles east of Salt Lake City and diversion facilities from Parleys Creek. The dam would create a 20,500 acre-foot lake for flood control and water supply. Advance planning has been completed; conditional construction funding was included in the FY 1985 Supplemental Appropriation Act (PL 99-88). A local cooperation agreement was signed 10 June 1986. Project construction was initiated in November 1986 with a road relocation contract. This work is expected to be completed by August 1987. Quarry development and core trench work is scheduled to begin in April 1988. The main dam contract is scheduled to be advertised for bidders in March 1989.

Completed Projects

A Corps of Engineers flood control project, Jordan River at Salt Lake City, was completed in 1960. The improvements consisted of enlarging 8,000 feet of Jordan River from Mill Creek to the head of Surplus Canal at 2100 South Street and 35,000 feet of Surplus Canal from Jordan River to Goggin Drain. Enlargement measures included channel excavation and levee construction; modification of the existing structure at the head of Surplus Canal; and reconstruction or modification of railroad bridges, street bridges, and irrigation facilities. Federal cost of the project was $1,227,600, and non-Federal cost was $463,000. Local interests maintain the project. The project provides protection to about 5,800 acres in western Salt Lake City and has prevented about $45 million in flood damages over the years, including $14.6 million during the 1983 flood and $18.0 million for 1984.

Other Federal Projects

Other major Federal projects in the basin which have been completed by the U.S. Bureau of Reclamation (USBR) are summarized as follows: (1) The Strawberry Valley Project (1906-191), which includes a transbasin diversion of water from the Colorado River drainage to the Great Basin for irrigation use in southern Utah County; (2) the Weber River Project (1928-1931), including diversion of water from the Weber River to Provo River for irrigation use in northern Utah County and southwestern Salt Lake County; and (3) the Provo River Project (1938-1952), including a transbasin diversion from the Colorado River Basin, a diversion from the Weber River, and regulation at the 150,000 acre-foot Deer Creek Reservoir on Provo River. Project water is used for irrigation and municipal and industrial purposes in northern Utah County and in Salt Lake County.

Another major USBR project, the Bonneville Unit of Central Utah Project, is under construction and includes features in both the Colorado River Basin and the Great Basin. The project includes a transbasin diversion from the Colorado River Basin to the Jordan River Basin. Facilities which relate to the study area include (1) potential diking plans for Utah Lake which may impact on outflow to Jordan River and (2) the construction of the Jordanelle Reservoir on Provo River from which an average of about 70,000 acre-feet annually of municipal and industrial water will be developed for use in Salt Lake County.

RESOURCES AND ECONOMY OF THE STUDY AREA

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

The paragraphs that follow describe the environmental setting and natural resources of the study area. Additional information on these subjects may be found in the accompanying environmental impact statement.

Description of the Study Area

The study area is within the Jordan River Basin of north-central Utah. The basin encompasses approximately 3,800 square miles, as shown on Plate 2. The basin includes all of Salt Lake and Utah Counties and portions of Wasatch, Carbon, Sanpete, and Juab Counties. Jordan River Basin is the most highly developed and densely populated area in Utah and includes the metropolitan area of Salt Lake City and the Provo-Orem metropolitan area. Salt Lake City is the capital of Utah and the center of political, industrial, cultural, and economic activities for the State and parts of adjacent states. Interstate Highways 15 and 80 provide transcontinental access in north-south and east-west directions, respectively, and connect with a network of national highways. The region is served by national and regional airlines, major railroads, and transcontinental bus lines. The population of the basin is about 1,020,000 (1986), which is nearly 60 percent of the population of Utah.

The principal stream in the basin is the Jordan River. It originates at the outlet of Utah Lake, flows northward 10 miles to the Jordan Narrows, and then flows about 40 miles through the Salt Lake Valley to its terminus in the Great Salt Lake. Jordan River drains an area which includes about 2,950 square miles tributary to Utah Lake. Flow at the outlet of Utah Lake is a function of lake elevation for stages at or above compromise elevation 4489.04 feet, the elevation at which the gates are to be opened and natural outflow is allowed to occur. Below compromise elevation the outflow is supplemented, as necessary, by a pumping station to maintain sufficient streamflow to meet irrigation demands. The stream gradient is very flat for the first 10 miles from the lake to the Narrows, a natural restriction created as the river passes through the Traverse Mountains. The slope steepens below the Narrows, then gradually flattens in the downstream direction. Several diversions are made at various points along the river for agricultural, municipal, and industrial purposes. The Jordan River intercepts seven major tributaries in Salt Lake Valley. These include Little Cottonwood Creek, Big Cottonwood Creek, and Mill Creek, which originate in the Wasatch Mountains southeast of Salt Lake City and traverse suburban bench and valley lands en route to the Jordan River. Parleys Creek, Emigration Creek, Red Butte Creek, and City Creek drain the Wasatch Mountain watershed above Salt Lake City and flow through portions of Salt Lake City in underground conduits prior to discharging to the Jordan River. All of these streams are largely diverted near the canyon mouths and are used for municipal and irrigation purposes. Streams draining the Oquirrh Mountains, along the west side of Salt Lake Valley, are ephemeral.

The Upper Jordan River interim area is located totally in Salt Lake County and includes the Jordan River from the Jordan Narrows to the Mill Creek confluence and the drainages of Little Cottonwood, Big Cottonwood, and Mill Creeks. The interim area is shown on Plate 1. From Jordan Narrows downstream to the mouth of Mill Creek, Jordan River has a relatively small channel that meanders through one-half mile wide bottom lands which are primarily agricultural lands. A number of highways and water and sewer lines cross the river in the study reach. Other stream-related developments include diversion structures and adjacent wastewater treatment facilities. Flood plain improvements include scattered mobile home parks, residential developments, golf courses, and park areas.

Little Cottonwood, Big Cottonwood, and Mill Creeks originate at high elevations in the Wasatch Front and flow westerly to the valley floor and their confluences with the Jordan River. The streams flow through narrow, deep canyons in the mountainous region and are deeply entrenched in prehistoric Lake Bonneville terraces at the foothill line. Below the terraces, Little Cottonwood and Big Cottonwood Creeks flow through relatively wide, depressed channels. Mill Creek flows through a channel on the crest of an alluvial ridge extending essentially to the Jordan River. The drainage areas of Little Cottonwood, Big Cottonwood, and Mill Creeks are approximately 40, 77, and 35 square miles, respectively. The tributary streams traverse suburban residential, commercial, and industrial developments. Lands adjacent to Mill Creek are highly developed; those adjacent to Big Cottonwood Creek are largely developed; and lands adjacent to Little Cottonwood Creek are only partially developed.

Geology, Soils, and Topography

Geology, soils, and topography of the area are somewhat interrelated and are a product of deformation and faulting associated with the Wasatch and Oquirrh Mountain ranges which bound Salt Lake Valley, on the east and west, and the Traverse Mountains to the south.

The ancient Lake Bonneville covered Salt Lake Valley up to a maximum elevation of about 5,090 feet. The rising and falling and periods of intermittent stabilization resulted in the formation of benches and shoreline features which are still visible after 15,000 to 16,000 years. Geologic composition is complex and includes igneous and metamorphic rock in the mountain and higher bench areas and sedimentary formations in the lower bench and valley areas. Soils range from heavy-clay textured near the Great Salt Lake to loamy on lake terraces. On the higher terraces, soils are composed of sand, silts, and clays. In the mountain valleys, soils are commonly shallow, coarse textured, well-drained, and composed of gravels and boulders from glacial activity, stream erosion, and landslides.

Topography of the Jordan River Basin varies from rugged mountains and deep canyons to the relatively flat, gently sloping valley floor. Valley elevations range from 4,200 feet near Great Salt Lake to about 5,200 feet on the terraces at the base of the Wasatch Mountains, which rise to elevations over 11,000 feet.

Climate and Runoff

Climate of the upper Jordan River area is temperate and semiarid, with four well-defined seasons. Temperatures range from winter lows around -30°F to summer highs near 105°F in the valley. Temperatures decrease about 4 degrees per 1,000 feet for higher locations in the basin. Average valley frost-free dates are April 10th in the spring to about October 20th in the fall.

Precipitation amounts vary with elevation. Normal annual precipitation ranges from about 12 inches near the southern end of Salt Lake Valley to over 60 inches in the higher mountain elevations. Precipitation during late fall, winter, and early spring occurs principally as snow in association with general storms and results in snowpack accumulations in the high elevations during the October through April period. During summer and fall, precipitation results primarily from cloudburst storms. Average monthly temperatures and precipitation for the Salt Lake City Airport and the Silver Lake-Brighton Station located in the Little Cottonwood Creek watershed are shown in Table 1.

TABLE 1

AVERAGE MONTHLY TEMPERATURES AND PRECIPITATION 1/

MONTH	Salt Lake City Airport (Elevation: 4,220 feet)		Silver Lake-Brighton (Elevation: 8,700 feet)	
	Average Temperature (°F)	Average Precipitation (Inches)	Average Temperature (°F)	Average Precipitation (Inches)
January	28.0	1.27	19.0	2.45
February	33.4	1.19	20.4	4.80
March	39.6	1.63	23.5	5.53
April	49.2	2.12	32.2	4.50
May	58.3	1.49	41.2	2.87
June	66.2	1.30	46.2	2.65
July	76.7	.70	57.9	1.28
August	74.5	.93	56.3	1.95
September	64.8	.68	48.9	1.74
October	52.4	1.16	39.2	3.05
November	39.1	1.31	27.5	4.75
December	30.3	1.39	21.2	5.34
Average Annual	51.0	15.17	36.3	40.91

1/ Source: Climatological Data Annual Summary, Utah 1982.

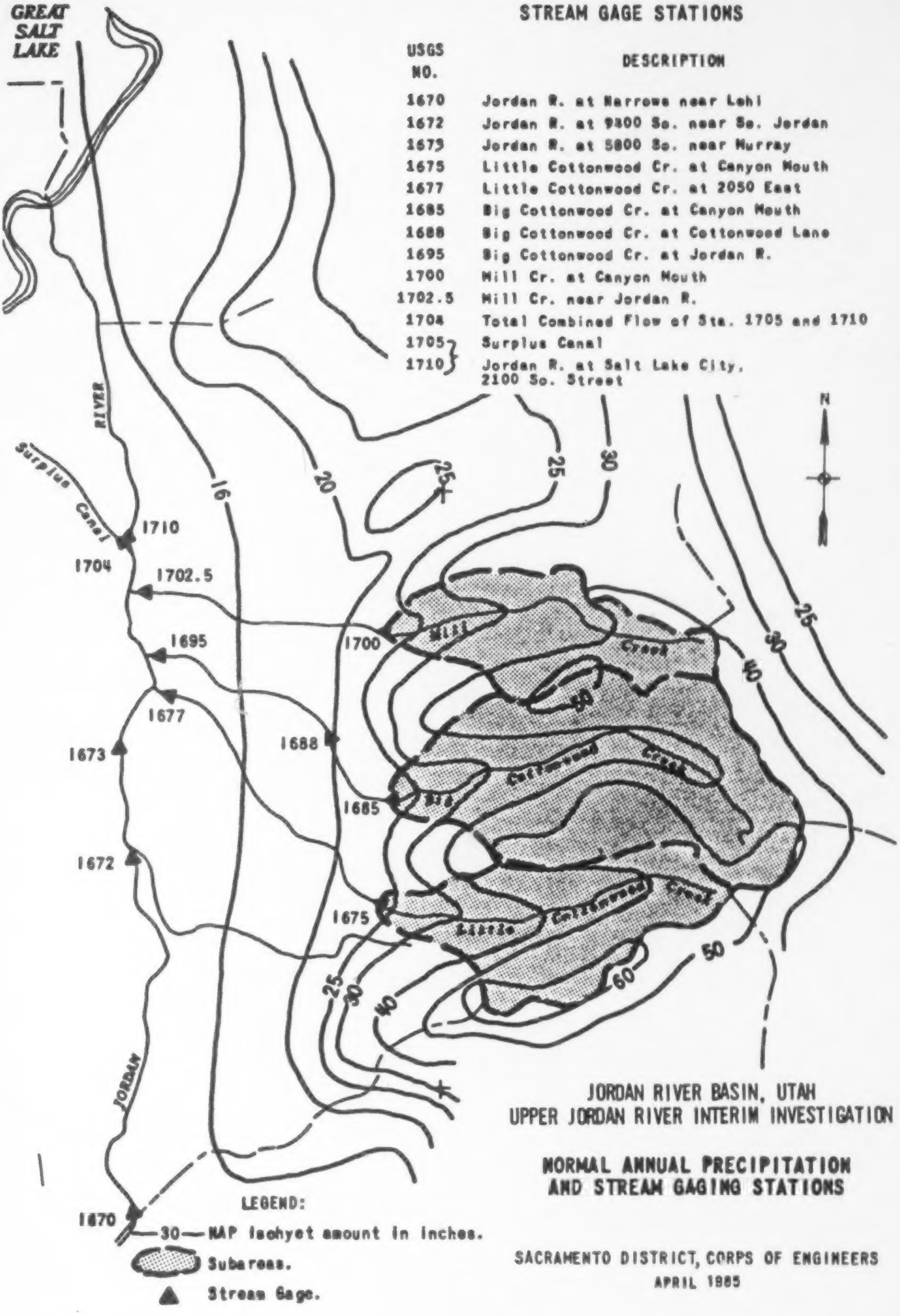
Three types of runoff common in the Jordan River basin are (1) snowmelt, (2) summer thunderstorms, and (3) general rainstorms. Runoff occurs from these events individually, or from a combination of snowmelt with either type of rainstorm. Valley runoff increases with urbanization and associated developments due to the decreased pervious area. Snowmelt runoff occurs in the valley about 2 weeks prior to mountain runoff. Peak snowmelt runoff normally occurs during the months of April through June. Runoff from thunderstorms is much smaller in volume than from snowmelt; however, peak flows are often higher but are of short duration because of the smaller contributing area. Streamflow records for Jordan River at Jordan Narrows near Lehi date from the year 1913. Other gaging stations were established along the Jordan River in 1942 and 1965. Streamflow records are available at the canyon mouths on the tributary streams for discontinuous months from 1898-1913; continuous records extend from 1914. Other stream gages on these streams were established in 1913, 1963, and 1964. Figure 1 shows the location of major stream gages. Maximum recorded flows and annual runoff at selected stream gages are summarized in Table 2.

TABLE 2

HISTORIC STREAMFLOW DATA

Stream Gage	Average Annual Runoff (1,000 acre-feet)	Maximum Daily Discharge (cfs) 1/	Maximum Daily Discharge Date	Discharge Peak (cfs)	Date (if different)
Jordan River at 2100 South (includes Surplus Canal)	286	1,756	6/07/52		
		1,564	9/18/78	2,220	
		2,482	9/26/82	2,540	
		3,350	6/12/83	-	
		4,510	6/01/84	4,800 2/	
		2,634	5/11/85	-	
Jordan River at Narrows (includes canal diversions)	266	1,410	6/10/52	-	
		2,150	6/23/83	-	
		3,030	6/20/84	3,100	
		1,580	4/18/85	-	
Little Cottonwood Creek at Canyon mouth 4/	48	762	6/11/21	-	
		3/	9/26/82	890	
		507	7/09/83	819	
		635	6/01/84	874	5/31/84
		287	6/08/85	416	
Big Cottonwood Creek at Canyon mouth 4/	53	848	6/08/12	-	
		3/	9/26/82	980	
		668	5/31/83	849	5/30/83
		765	5/31/84	979	6/01/84
		308	5/10/85	337	
Mill Creek at Canyon mouth	11	152	5/20/49	-	
		3/	9/26/82	43	
		172	5/30/83	241	
		134	6/01/84	150	
		69	5/10/85	88	

1/ Cubic Feet per second.
2/ Approximate.
3/ Data unavailable.
4/ Discharge data represent flows through flumes at canyon mouths. Water often bypasses flumes and flows directly to hydroelectric and water treatment plants.



STREAM GAGE STATIONS

USGS NO.	DESCRIPTION
1670	Jordan R. at Narrows near Lehi
1672	Jordan R. at 9400 So. near So. Jordan
1673	Jordan R. at 5800 So. near Murray
1675	Little Cottonwood Cr. at Canyon Mouth
1677	Little Cottonwood Cr. at 2050 East
1685	Big Cottonwood Cr. at Canyon Mouth
1688	Big Cottonwood Cr. at Cottonwood Lane
1695	Big Cottonwood Cr. at Jordan R.
1700	Mill Cr. at Canyon Mouth
1702.5	Mill Cr. near Jordan R.
1704	Total Combined Flow of Sta. 1705 and 1710
1705	Surplus Canal
1710	Jordan R. at Salt Lake City, 2100 So. Street

LEGEND:

30— NAP Isohyet amount in inches.

▨ Subareas.

▲ Stream Gage.

JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

**NORMAL ANNUAL PRECIPITATION
AND STREAM GAGING STATIONS**

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985

FIGURE I

The Jordan River flows from Utah Lake are largely regulated for irrigation and industrial uses. The outlet to the river was modified in 1872 by a dam and gated structure, and pumps were later installed to withdraw water and permit a drawdown of about 9 feet below the compromise level of 4489.04 feet. Except during periods of very large snowmelt runoff, most of the flow in the Jordan River at Jordan Narrows is diverted into four major irrigation canals. Other diversions occur near 13800 and at 9400 South Streets. Ground-water accretion and tributary inflow result in the river being a gaining stream between the diversion points and the Surplus Canal heading near 2100 South Street. The annual flows of Jordan River upstream from the diversion at Jordan Narrows generally fall within the relatively narrow range of 180,000-300,000 acre-feet because of the regulated outflow from Utah Lake. However, during 1983 the annual flow was 929,000 acre-feet, whereas during 1935 the annual flow was only 76,000 acre-feet. The average annual flow in the six major tributary streams emerging from the Wasatch Mountains has ranged from about 54,000 (1934) to 304,000 (1983) acre-feet. Storage on the study area streams of Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek is limited to about 1,700 acre-feet in two reservoirs on Big Cottonwood Creek. Local surface water supplies are supplemented by importation of about 80,000 acre-feet of high quality water from Provo River, which is partially regulated by the existing 150,000 acre-foot Deer Creek Reservoir. Ground-water occurs in subsurface materials underlying Salt Lake Valley. The total quantity of water stored in the valley fill has been estimated at 60 million acre-feet, a quantity that equals the cumulative flow of Jordan River at Jordan Narrows for more than 200 years. However, in recognition of annual recharge and practical storage drawdowns, the limit of continuous withdrawals from existing pumping centers is between 150,000 and 200,000 acre-feet annually. Average water withdrawals from surface and ground water sources in Salt Lake County for the 1970-75 period and the total diversion for major uses are shown below.

Average Annual Withdrawals (1970-75)

	Surface Water (Acre-Feet)	Ground Water (Acre-Feet)	Total (Acre-Feet)
Residential and Municipal Use	81,000	54,000	135,000
Irrigation Diversions	291,000	6,000	297,000
Industrial Diversions	108,000	52,000	160,000
Stock Water	0	34,000	34,000
TOTAL	480,000	146,000	626,000

Water supply is generally adequate to meet needs; however, shortages occurred in 1934, 1935, 1941, 1961, and 1977.

Vegetation

Native vegetation is highly varied due to great differences in topography, precipitation, temperatures, and soils. Two vegetation zones, the mountain-valley and submontane-foothill, are important in the study area. The mountain-valley vegetation is predominantly the desert-shrub community which occurs at lower elevations under dry conditions and includes sagebrush, rabbitbrush, greasewood, and shadscale. The agricultural community occurs in rural areas of the valley and benchlands and includes alfalfa, small grains, corn, fruit orchards, and pastureland. The riparian river-bottom community is dominated by cottonwoods, willows, and smaller woody species such as wildrose, Virginia plum, hawthorn, box elder, and honeysuckle. Understory is mostly grasses, sedges, and forbs.

The submontane-foothill shrub zone extends roughly from the foothills at elevations between 5,000 and 6,000 feet to the montane conifer-aspen zone at about 8,000 feet. Shrub communities within this zone also occur on the drier and more exposed slopes of the mountain ranges. This zone consists largely of intermixtures of mountain brush, oakbrush, sagebrush-grass, and streamside riparian communities. The mountain-brush species include mountain mahoganies, bitterbrush, sagebrush, gambel oak, dwarf maple, juniper, snowberry, serviceberry, chokecherry, and other shrubs. The oak brush community is dominated by gambel oak, with grasses and forbs as understory. The sagebrush-grass community is dominated by sagebrush, with grasses and forbs as ground cover. Streamside riparian communities include cottonwoods and willows in the lower reaches and mountain brush in the upper reaches. There are no known rare or endangered plant species in the study area.

Fish and Wildlife

The study area tributaries to Jordan River contain populations of brook, brown, rainbow, or native cutthroat trout, primarily in the canyon reaches. Fish populations are supplemented by the stocking program of the Utah Division of Wildlife Resources (DWR). Each stream fishery has been classified according to habitat conditions under the Utah Waters Inventory and Classification, 1970.

Mill Creek from the Jordan River upstream to the canyon mouth (6 miles) extends through urban Salt Lake City and is bordered primarily by exotic plants. Bank stabilization and shading are poor. Streamflow is variable but sustains a limited fishery except for dewatered reaches. Resident fish include rainbow trout, brown trout, carp, longnose dace, Utah sucker, mountain sucker, and walleye. The Utah DWR believes that, with a guaranteed minimum flow and water quality improvement, a valuable trout fishery could be established. From the canyon mouth upstream to Elbow Fork (8.8 miles), the reach gradient is moderate. Streambanks vary from badly denuded as a result of overuse by recreationists to well vegetated and stabilized reaches. Stream shading and flow are currently adequate for maintenance of a moderate fishery consisting of rainbow, brown, and cutthroat trout. The DWR supplements the naturally reproducing fishery with catchable rainbow trout to withstand considerable angling pressure. The canyon reach of Mill Creek is considered an important fishery.

Big Cottonwood Creek from the Jordan River upstream to the canyon mouth (9 miles) extends through suburban Salt Lake City and is bordered primarily by exotic vegetation. Bank stabilization and shading are poor. Resident fish species in this reach include brown trout, carp, speckled dace, longnose dace, Utah sucker, and mountain sucker. The DWR has classified this reach of Big Cottonwood Creek as a limited fishery which could be improved with sustained streamflow and water quality improvement. The canyon reaches of Big Cottonwood Creek are vegetated along the banks by native vegetation. Streamflow is affected by diversions to a powerplant for a limited reach. Moderate populations of self-reproducing brown and rainbow trout exist, except in the dewatered reach. The fish population is augmented by annual stocking of catchable rainbow trout. The canyon reach is classified as a valuable fishery with limiting factors being heavy fishing pressure and fluctuating flows.

Little Cottonwood Creek from the Jordan River to the canyon mouth (12.2 miles) flows through industrial, commercial, and residential areas and is primarily bordered by exotic vegetation or is denuded. The lower reach is degraded by channelization, diffuse and point-source pollution, dewatering, and littering. The State Division of Wildlife Resources, however, has reported improved fishery conditions with white bass, walleye, sunfish, and channel catfish moving into this reach, possibly as a result of the last couple of high water years. This upper valley reach is of moderate gradient and flows through privately owned lands, with somewhat restricted access. Streamflow is extremely variable, and periodically the stream is totally dewatered below diversion sites. The stream could be upgraded with a sustained minimum flow. The canyon section extends through interspersed public and private land. Streamside vegetation consists of native vegetation. Streamflow is adequate for maintenance of a modest population of cutthroat, rainbow, and brown trout. The canyon reach is a valuable fishery except for areas subject to periodic dewatering.

Jordan River from the confluence with Little Cottonwood Creek downstream to 2100 South Street is low gradient with a poor pool-to-riffle ratio. Extensive channelization, high turbidity, and sewage effluents from rural and suburban areas have severely limited the potential productivity of the river. Primary resident fish species found are carp, the Utah chub, and the Utah sucker. Natural fish propagation is poor, and no supplemental stocking is done. Access is limited as virtually all adjacent lands are privately owned and posted. The DWR has designated this reach of the Jordan River as a limited fishery due to poor water quality and channelization.

No fish species in the study area streams are Federally listed as endangered and threatened species.

Wildlife species typical of the Wasatch Mountain Range canyons are mule deer, coyote, raccoon, white-tailed jackrabbit, blue grouse, great horned owl, Rocky Mountain elk, red-tailed hawk, common flicker, starling, yellow warbler, sagebrush lizard, and a small population of Rocky Mountain goat which was introduced into the area in 1967. Various wildlife habitat communities have been largely affected by suburban, rural, and agricultural developments. Through disturbance, the indigenous plant communities have been replaced by exotic types, and many of the native wildlife species have been displaced. Upland game such as pheasant and mourning dove compete with smaller population of chukar partridge, sage and forest grouse, and quail. Wildlife species, found in the undisturbed riparian zone adjacent to the Jordan River, include muskrat, ground squirrel, and cottontail rabbit. While there are numerous wetlands along the Jordan River, shorebird and waterfowl use is minimal due to both limited aquatic plant growth and poor water quality. Upland birds such as pheasants and quail are found along the more heavily vegetated sections close to agricultural areas. Numerous species of passerine birds such as the belted king-fisher, robin, and American goldfinch are found along the entire reach. Several species of reptiles, largely lizards and a few non-poisonous snakes, are also found along the Jordan River. The basin provides habitat for two wildlife species Federally listed as endangered: the peregrine falcon and the bald eagle. The peregrine falcon normally nests on cliff ledges and feeds in open prairie-type environment. Peregrine falcons have been observed in Salt Lake City perching on high rise buildings and feeding on pigeons. The bald eagle is currently dispersed throughout Utah from October to April as a winter visitor, coming from as far as Saskatchewan, Canada. The State Division of Wildlife Resources reports a bald eagle roost site located northwest of Salt Lake City and several golden eagle nest sites on Lake Mountain west of Utah Lake and in the Wasatch Mountains east of Salt Lake Valley.

Water Quality

Water quality in Salt Lake County presently ranges from excellent in the upper Wasatch Mountains to poor in the lower reaches of the Jordan River and tributary streams. In the canyon portions of Mill, Big Cottonwood, and Little Cottonwood Creeks, the total coliform counts (a measure of domestic pollution) range upward to about 160-1250 MPN (most probable number)/100 milliliters (mL) which is below the allowable limits for public water supply (5,000 MPN/100 mL). The standards for primary and secondary water contact recreation (1,000 and 5,000 MPN/100 mL, respectively) are also generally met. On the tributary streams the total coliform counts range upward to 8,000 MPN/100 mL in the lower reaches and in the Jordan River range upward to 80,000 at the Narrows to 200,000 at 9000 South Street.

Five-day BOD (a measure of the organics present) ranges from a high of about 2.6 milligrams per liter (mg/l) in upper stream reaches to 10-16 mg/l in the lower reaches compared with an acceptable standard of 5 mg/l. Dissolved oxygen is generally at acceptable levels (5-6 mg/l) except in portions of the Jordan River where values as low as 4.1 mg/l have been measured at 1700 South Street. Reason for the degradation in the lower reaches is that much of the high quality water is diverted at the canyon mouths, and valley return flows from urban runoff, agricultural return flows, and municipal and industrial discharges lower the quality of water in the streams. In the upper reaches of the tributaries, water quality is suitable for practically all uses. Flow in the Jordan River and the lower reaches of the tributaries is generally satisfactory for irrigation and certain industrial uses but is unacceptable for municipal and certain manufacturing purposes and water contact recreation.

Air Quality

Air quality in the Jordan River Basin varies with topography and prevailing wind and weather patterns. Primary concerns include ozone levels and carbon monoxide resulting from industries and automobile emissions during periods of temperature inversion in winter months when air is trapped in the valley and becomes stagnant. During 1983 the National Ambient Standard for particulates was exceeded only once in Salt Lake City. Carbon monoxide levels were on occasion slightly above standard limits, and ozone exceeded the 1-hour standard for a total of 3 days. Sulfur oxides remained well below acceptable limits. Increases in population density and concentration of industrial facilities have contributed to higher pollution levels in Salt Lake County.

Cultural Resources

The Jordan River area of the eastern Great Basin has been the scene of human occupation for at least the past 10,000 years. The intervening time to the historic period has been divided into a number of periods based upon anthropological data, each period representing either different cultures or cultural adaptations to the environment. These include the Paleo-Indian/Big Game Hunter Period (? to 9,000 B.P.), the Archaic Period (8,500 to 650 B.P.), the Sevier/Fremont Period (1,600 to 650 B.P.), and the Numic/Paiute-Shoshoni Period (750 B.P. to Historic Period).

Although Spanish explorers first entered the area in the late 1700's and both traders and trappers passed through the area during the first half of the 19th Century, it was not until 1847, when Brigham Young led the Mormon pioneers into the Great Salt Valley, that Anglo-Europeans began to exert a strong influence in the area. Early historic period land-uses (primarily directed toward farming, irrigation and water supply systems, ranching, mining, and urban/suburban development) intensified markedly over time, especially after construction of railroads into the area in the 1870's.

Based solely on previously recorded information, a total of 41 prehistoric period and 129 historic period cultural resources are known to exist within Salt Lake County. Of the latter type, most are private homes and public buildings which have been listed on, or determined eligible for listing on, either the National Register of Historic Places or the State of Utah's Historical Register.

Socioeconomics

The 1986 population of Salt Lake County surpassed 700,000 and accounts for 44 percent of the State population of about 1,600,000. From 1970 to 1980, Salt Lake County population increased from about 458,600 to 619,000, representing a growth rate of over 3 percent per year. The growth rate from 1980 to 1985 was about 2.5 percent per year.

Salt Lake County has a total area of about 489,000 acres, of which 287,000 are valley and foothill lands subject to development. Presently, about 122,000 acres of developable land are used for urban, suburban, and related purposes; about 71,000 acres are used for agriculture; and about 94,000 acres are undeveloped marsh and dry areas. Ongoing land use changes are associated with urbanization to accommodate population growth, commercial and industrial expansion, and associated supporting developments. With increased population, urban development has been moving southward in Salt Lake County. In the 1940's, lands adjacent to Mill Creek were only sparsely developed, but by 1970 they were almost completely developed. About 1970 development began on lands adjacent to Big Cottonwood Creek and has subsequently increased. The area in the vicinity of Little Cottonwood Creek is following the same pattern.

The early economic development of Salt Lake Valley centered around agriculture and the processing of agricultural products. Agriculture is still important to the economy of the area, but the region has developed primarily as an urban center with a broad commercial and industrial base. Economic activity includes mining and refining of copper, molybdenum, silver, gold, and zinc; production of steel and chemical products; and manufacture of aircraft parts, computer and electronic components, mobile homes, petroleum products, salt, and a wide variety of other products. Sperry Corporation, Hercules, National Semiconductor Company, Delta Airlines, American Express, and Park-Davis Pharmaceuticals are just a few of the companies and corporations that operate large facilities in the immediate area. In 1985 the total nonagricultural employment in Salt Lake County was about 325,400, including about 85,500 in trades, 71,500 in services, 52,900 in government, 48,300 in manufacturing, over 24,500 in transportation, communication, and public utilities; over 22,100 in finance, insurance, and real estate; and about 18,300 in construction and nearly 2,300 in mining.

Unemployment in Salt Lake County during 1985 was about 5 to 6 percent of the work force. Per capita personal income in Salt Lake County in 1984 was $11,000, which was below the national average of $12,800 but higher than the Utah State average of $9,900.

FUTURE CONDITIONS

Urbanization within Salt Lake County is expected to continue in the future, with population projected to reach 800,000 by 1993 and 900,000 by the year 2000, representing a yearly growth rate of about 1.8 percent. As a result, certain physical and environmental changes are expected. However, most physical characteristics will remain unchanged; i.e., climate, soils, and geology. Land use changes and local drainage measures will affect the magnitude and patterns of floods, and existing flood plain developments will be subjected to more frequent and greater magnitude of flooding.

Effects of Urbanization include the following:

- Continued urbanization will increase imperviousness and consequently increase urban runoff from rainfall. As a result, additional storm drains will be required to discharge additional runoff into the streams.

- Agricultural, natural, and riparian vegetation will be reduced as development continues in the valley portion of tributary areas. Only minor changes in vegetation are expected immediately adjacent to the streambanks.

- Wildlife will be displaced as developments are constructed within the tributary valley areas. Easier accessibility to and use of canyon and mountain areas will place increased pressure on wildlife to retreat to less populated areas.

- Air pollution will increase, making air quality standards more difficult to meet.

- Topography in flood plain areas could be altered slightly by excavation and placement of fill material during construction.

- More ground water can be expected to be pumped from deep aquifers, but ground water in the flood plain area is not expected to change significantly.

- Some water quality improvement is expected in the future as a result of the 208 Water Quality Management Plan, including upgrading of effluent from sewage treatment plants. However, valley segments of the Jordan River and tributaries are expected to continue to be designated "water quality limited" for beneficial uses. Structural flood control facilities, including storm drains discharging into the streams, and channelization are expected to continue to adversely impact the water quality.

- The fishery will continue to depend upon stocking by the State. Streamflow diversions will continue to severely limit the fishery potential unless minimum streamflows are provided.

- Due to the lack of cultural resource inventories, construction impacts to these values cannot be determined. Project development, however, will likely reduce impacts to historic and prehistoric resources as a result of future flood events.

- The potential for flooding in parts of Salt Lake Valley is not expected to influence growth or economic activity, but growth may shift to areas unrestricted by zoning and regulation.

PROBLEMS AND OPPORTUNITIES

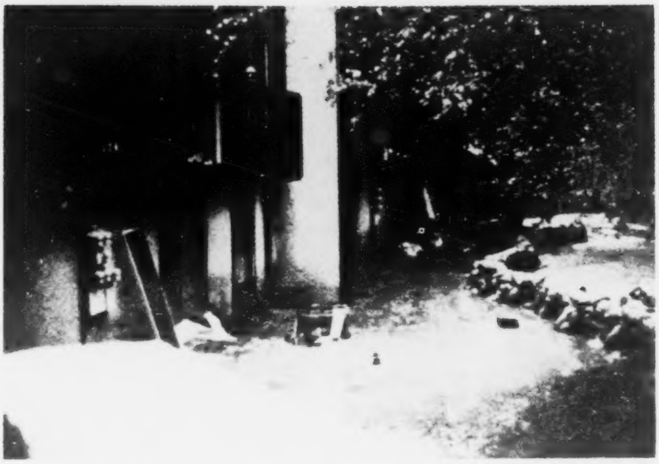
The primary water-related problem assessed herein is flooding. Other problems, including the need for additional water supplies, improvement of water quality, enhancement of fisheries, and providing recreation opportunities, have undergone analysis as opportunities are created in association with flood control alternatives.

FLOOD PROBLEMS

Jordan River and tributary streams have a long history of flooding. Accounts indicate that flooding is most commonly associated with snowmelt runoff; however, flooding has also occurred from summer thunderstorms, general rainstorms, and from a combination of snowmelt and rainfall. Jordan River flooding is closely associated with the stage of Utah Lake. Historical Jordan River flooding occurred during the periods 1884 to 1886, 1907, 1909, 1910, 1921-23, 1952-53, and 1982-86. In the majority of these years, flooding was most severe during the major snowmelt period, April through June, and was intensified by inflow from the tributary streams. With the exception of the rainflood in September 1982, peak annual flow of the Jordan River has been associated with snowmelt flooding. Historical flooding on the tributary streams dates to 1869; however, streamflow data are not available prior to 1900, and flood accounts are sketchy. Snowmelt runoff exceeded channel capacities in 1907, 1909, 1912, 1921, 1928, 1952, 1953, 1957, 1975, 1983, and 1984 on one or more of the tributary streams. Accounts indicate rainfall flooding occurred during the July through September period in 1916, 1925, 1930, 1936, 1944, 1951, 1956, 1961, 1965, 1969, and 1982 on one or more of the tributary streams. Accounts of damages are limited (except for 1982) due to the lack of streamflow data in the vicinity of the problem areas and due to the limited development in the affected reaches. Damage information from the 1982 rain flood suggests that rainfall flooding along the tributary streams is being exacerbated by urban development. Historical flood and damage data for the 1952 snowmelt flood, the September 1982 rainflood, and the 1983 and 1984 snowmelt floods are shown in Table 3.

Jordan River Flooding. September 1982.
Flooding up to 3 feet in overbank areas forced evacuatio
of several mobile homes.

Jordan River flooding. June 1984.
Local interests averted damages to developed areas
during 1983 and 1984 by construction of advance measures levees.



Little Cottonwood Creek flooding. September 1982.
Willows Apartment Complex below 5600 South Street.
Many units were flooded up to 2-3 feet.

Little Cottonwood Creek at 6600 South. May 1984.
Bridge washout.

Big Cottonwood Creek flooding, May 28, 1982.
Cottonwood Cove development east of State Street
flooded up to 2 feet in depth.

September 1982, flooding again at Cottonwood Cove
up to 3 feet in depth.

Mill Creek near 1100 East Street.
Mill Creek Way between 1100 East and 900 East was used as an open floodway during the spring of 1983.

Mill Creek. August 1983.
Sandbags and other flood fight efforts reduced damages; however, several bridges were washed out or removed; temporary bridges provided access.

TABLE 3

HISTORICAL FLOOD AND DAMAGE DATA

Streams/Date of Flood	Peak Flow (cfs)	Exceedence Interval 3/ (years)	Estimated Damage 4/ At Time of Flood ($1,000)
Jordan River at 2100 South			
07 Jun 1952	1,756 1/	10	667
26 Sep 1982	2,540	20	Minor
12 Jun 1983	3,400	30	5,600 7/
01 Jun 1984	4,800 2/	50	3,000 2/
Little Cottonwood Creek at Canyon Mouth			
25 Jun 1952	736 1/	20	NA
26 Sep 1982	890	50	2,000 5/
09 Jul 1983	819	45	8,100 5/
31 May 1984	874	80	8/
Big Cottonwood Creek at Canyon Mouth			
25 Jun 1952	503 1/	5	NA
26 Sep 1982	980	80	2,000 5/
30 May 1983	849	200	2,900 5/
01 Jun 1984	979	900	8/
Mill Creek at Canyon Mouth			
25 May 1952	102 1/	10	NA
26 Sep 1982	43	8	3,863 6/
30 May 1983	241	1000	2,630
01 Jun 1984	150	70	8/

1/ Mean daily flow.
2/ Approximate.
3/ Jordan River flow-frequency data from Utah Lake-Jordan River-Salt Lake County Phase 1 Report Oct 1984. Flow-frequency data for tributaries from Upper Jordan River Interim Hydrology Report May 1984.
4/ Includes channel erosion damages.
5/ Estimated breakdown between Big and Little Cottonwood Creeks.
6/ Includes Mill Creek and a portion of Salt Lake County. Damages are largely attributable to high inflows in urban areas below the Canyon Mouth.
7/ Exclusive of $1.1 million rehabilitation costs on Surplus Canal and damages of about $0.3 million on Lower Jordan River.
8/ Public facility damage, flood fight, and clean-up costs estimated at about $3 million for Salt Lake County.

Flood problems along streams in the upper Jordan River basin persist because flood control improvements have lagged behind growth and development. Flood problems have intensified with time due to encroachment of flood plain areas and increased runoff from urban and suburban development. In the urban areas, storm drains have been installed to reduce damage from cloudburst floods in the collection area but have increased inflow to the streams where compensatory storage or channel improvements have not been made. Table 4 shows the approximate channel carrying capacity at critical locations on the streams at the inception of the investigation.

TABLE 4

CHANNEL CARRYING CAPACITIES
(WITHOUT LOCAL IMPROVEMENTS CONDITION)

Stream	Reach	Channel Capacity (cfs)
Mill Creek	(1) Wasatch Blvd to Highland Dr.	150
	(2) Highland Dr. to 700 E.	200
	(3) 700 E. to State St.	230
	(4) State St. to Jordan R.	300
Big Cottonwood Creek	(1) Wasatch Blvd to 6200 South	600
	(2) 6200 South to Highland Dr.	600
	(3) Highland Dr. to State St.	400-500
	(4) State St. to Jordan R.	500
Little Cottonwood Creek	(1) Wasatch Blvd to 6600 South St.	500
	(2) 6600 S. to 900 East	650
	(3) 900 East to State St.	650
	(4) State St. to Jordan R.	600
Jordan River	(1) Jordan Narrows to Little Cottonwood Cr.	800-1,000
	(2) Little Cottonwood Cr. to Mill Cr.	2,000-3,000

Flood plains for the study area streams are shown on Plate 3, sheets 1 through 3 for Mill Creek, Big Cottonwood Creek, Little Cottonwood Creek, and the Jordan River. The flood plains depict the areas affected by the 100- and 500-year floods for 1980 hydrologic and hydraulic conditions. Flow-frequency data and estimated flood damages are included under the Technical Studies section.

WATER SUPPLY NEEDS

Rapid growth of population and economic activity is expected to continue in Salt Lake County and will intensify the demand for additional water supplies. In addition, some of the conveyance facilities have been in use for nearly 100 years and need to be upgraded. The annual firm system yield of the combined sources of supply total about 189,400 acre-feet, as shown in the tabulation below.

Supply Sources	Annual Dependable Yield (acre-feet)
Wasatch Front Streams	62,200
Salt Lake City Wells & Springs	20,800
Salt Lake County Wells	50,000
Provo River Project (USBR)[1/]	56,400
Total	189,400

[1/] U.S. Bureau of Reclamation

Useable supplies are adequate to meet current requirements; however, in the future, shortages are expected during critical runoff periods without additional water supply. The population of Salt Lake County is expected to reach over 900,000 by the year 2000, and municipal and industrial (M&I) water requirements are expected to increase to over 250,000 acre-feet by the year 2000. Sources of supply expected to be used to meet future demands include 2,900 acre-feet from the authorized Corps of Engineers Little Dell Lake project and 70,000 acre-feet from the Bonneville Unit of Central Utah Project (USBR), which is under construction. Other potential sources of supply include irrigation conversion, 10,000 acre-feet; increased ground water use, 26,000 acre-feet; and increased use of local surface supplies, 10,000 acre-feet. Considering all available sources, the M&I demand could be met to beyond the year 2010. Development of local surface supplies has not been planned but could involve increased diversion and regulation of runoff on Mill Creek and Big and Little Cottonwood Creeks. Accordingly, solution of flood problems involving regulatory storage should include consideration of water supply development as a multiple-use function.

WATER QUALITY NEEDS

Water quality in the Jordan River and lower reaches of the tributary streams is generally of poor quality due to return flow from irrigation, municipal and industrial water supply uses, urban runoff from rainfall, construction site runoff, recreation use, and trash disposal. The pollution concentrations are high due to the inflow loading and the reduced flow due to diversions. A Section 208 Water Quality Management Plan, October 1978, included plans to reduce pollution. In particular, wastewater treatment facilities are being upgraded and measures to reduce pollution from other point sources are under consideration. The watershed and urban runoff and other nonpoint pollution sources continue to pose a problem due to sediment; suspended substances, including trace metals; and the presence of constituents typical of sewage effluents. For most suspended constituents the increased load during a storm is disproportionate to the increase in flow. Measurements show that in cases where urban runoff contributed about 50 percent of the flow, from 60 to 90 percent of the suspended solids and pollutants were contributed by storm runoff.

FISHERIES AND RECREATION

Fisheries in the study area streams are limited due to dewatering of stream reaches, erratic streamflow, and poor water quality. Recreation opportunities are similarly limited due to the poor water quality, erratic flow, and limited public access. Recreation development has lagged behind the demand for hiking and biking trails, day use picnic facilities, play-fields, swimming facilities, camping facilities, and golf courses. Local governmental entities support recreation development but are limited by financial resources and have been unsuccessful in getting approval for additional funds through bonding.

TECHNICAL STUDIES

Technical studies conducted to provide the basis for formulating and evaluating flood control alternatives, including hydrologic, hydraulic, and economic studies, are summarized in the following paragraphs. The data presented herein were used in identifying problems and the initial assessment of alternative plans prior to local interests' projects to mitigate damages of the 1982 to 1984 floods. Technical data reflecting recent local interest projects and updated conditions are presented as a part of the residual flood problem paragraph.

HYDROLOGIC STUDIES

Hydrologic studies include storm and flood analysis and development of flow-frequency relationships.

Storm and Flood Analysis

Storm and flood analysis consists of analyzing available data and developing precipitation/runoff models to represent the hydrologic behavior of the tributary drainage areas. Mountain and urban portions of the tributary streams were modeled separately to reflect their distinct characteristics. The Corps HEC-1 "Flood Hydrograph Package" was used for modeling purposes. Hydrologic models were developed to use unit hydrographs for the mountain areas and rainfall and runoff simulation for valley lands, and channel diversion simulation and channel routing options. Rainfall is the critical hydrologic event causing urban floods. General rain and thunderstorm floods for the urban area generally occur between April and October. The urban area runoff occurs from any major rainfall. This runoff is a direct result of making the ground surface more impervious to infiltration through construction of streets, parking areas, homes, and other buildings. The urban area is subject to continual change in the amount of imperviousness and the pattern which surface runoff takes. Urban runoff analysis includes the kinematic wave overland flow routing. The models were used to analyze the hydrologic conditions for present (1980) development, 1995 conditions, and ultimate development expected within 50 years. They were also used to analyze the effectiveness of alternative measures.

Rainfall duration, intensity, and frequency data were adopted from the NOAA Atlas 2, Volume VI, Utah. A storm duration of 3 hours was selected as being critical for analysis of individual tributary areas, and a 6-hour duration was selected for composite analysis.

Rainfall intensity data adopted for storms centered over the urbanized areas of Mill Creek and Big and Little Cottonwood Creeks are shown in the tabulation below for both the 3-hour and 6-hour durations.

Event	3-Hour Duration 10 sq miles (Inches)	6-Hour Duration 75 sq miles (Inches)
10-year	1.02	
25-year	1.26	1.41
50-year	1.41	1.55
100-year	1.60	1.77

Values for mountain areas were developed to reflect storm centerings above the canyon mouths and included adjustments to represent mountain precipitation and reduction in point rainfall for drainage areas over 10 square miles.

Rainfall distributions were adopted from the NOAA Atlas and other technical documents and were divided into 5-minute intervals for modeling purposes.

Precipitation losses were developed taking into account soil types, soil depths, topography, and infiltration rates. Infiltration rates and pondage losses were determined for both the mountain watershed and urban areas. Precipitation losses for mountain watershed areas are shown below.

	Infiltration Rate (In./Hr)	Pondage Loss 1/ (In.)	Impervious (Percent) 2/
Mill Creek at canyon mouth	0.78	1.50	8
Big Cottonwood Creek at canyon mouth	0.58	1.50	10
Little Cottonwood Creek at canyon mouth	0.56	1.50	16

1/ For general rainfall, pondage was assumed zero.
2/ Applied when rainfall intensity exceeds 0.2 inches per hour.

Urban area losses were estimated at zero to 1 inch initial losses for impervious and pervious areas, and zero to 1 inch uniform losses per hour for impervious and pervious areas.

The valley or urbanized portions of tributary drainage areas were subdivided into homogeneous areas for modeling purposes and to obtain hydrologic data at key locations. Index stations were assigned at key locations for data display purposes. Plate 7 shows the location of index stations. Computed runoff was routed overland to channels or other conveyance facilities, including existing and future storm drainage facilities.

Flood routings reflect channel shape, slope, roughness, and capacity, and include characteristics to simulate diversion and storage. Channel and overland flows were routed separately; however, flows were combined at the index locations.

Present and future land uses were determined from coordination with Salt Lake County officials, aerial photographs and projections of land use from Salt Lake Area Traffic Studies. Existing storm sewers were considered for present and future conditions. Both existing and expected future storm water systems were studied. The effects of storm sewers are most important when they cross natural drainage paths. In most cases the storm sewer flow was combined with the overland flow. Where storm drains crossed the natural surface drainage, the runoff up to its capacity was diverted to the next sub-area.

Pervious and impervious areas were estimated for each subarea and used in the model. The average impervious area for the composite of all streams was 25 percent for present conditions, 28 percent for future (1995) conditions, and 30 percent for fully urbanized conditions. Calibration of the hydrologic models included analysis of three documented storms and floods which occurred during 1982.

The following base flows from the canyon areas were combined with urban rainfall runoff.

Stream	Baseflow (cfs)
Mill Creek	50
Big Cottonwood Creek	200
Little Cottonwood Creek	200

Flow-Frequency Analysis

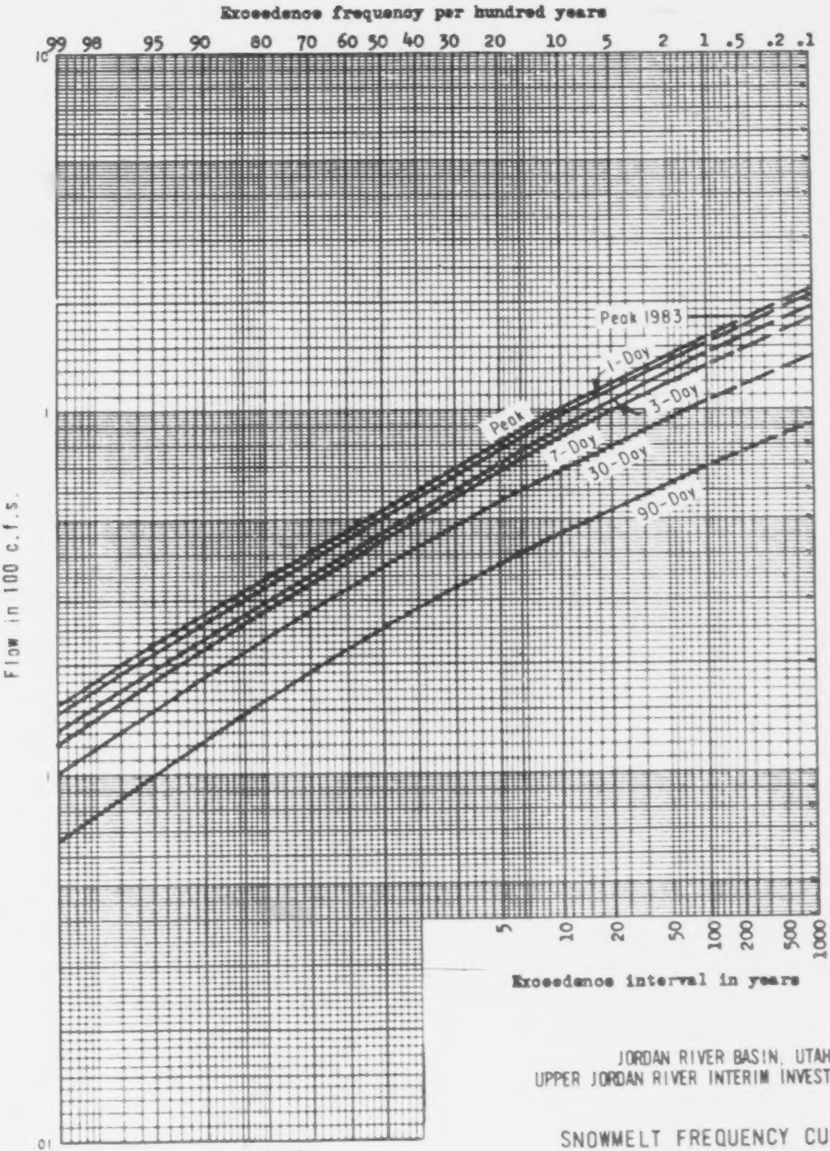
Flow-frequency analysis included the use of existing streamflow data and results from hydrologic modeling. Snowmelt and rainflood flow frequencies were developed and evaluated separately.

Snowmelt data were developed at the canyon mouths of Mill Creek and Big and Little Cottonwood Creeks and for the Jordan River at key locations based on the U.S. Geological Service (USGS) stream gaging locations and for the period 1899 to 1978. Records were supplemented by correlation with other records in the area to substitute for missing flow data.

Rainflood peak flow-frequencies were developed on each stream at the canyon mouths and at the selected index stations to reflect urban runoff. The data were developed to correspond with the selected conditions of land use.

Snowmelt flow-frequency relationships on the tributary streams at gaging stations are shown on Figures 2 through 4. These curves represent conditions before channel improvements were constructed by local interests. Flow-frequency data for the Jordan River were developed on a preliminary basis for four locations: the Jordan Narrows near Lehi, 9400 South Street, 5800 South Street, and for the total flow of Jordan River at 2100 South Street. Detailed hydrology on Jordan River was not accomplished due to a lack of a potential Federal project, as described hereafter.

Rainflood flow-frequency curves for present conditions for Mill Creek are shown on Figure 5; for Big Cottonwood Creek on Figure 6; and for Little Cottonwood Creek on Figure 7. Rainflood peak flow-frequency curves for future conditions for Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek are shown in Figures 8, 9, and 10, respectively. These curves represent the without local interest improvement condition. Table 5 displays flow-frequency data at selected points on each tributary stream for the 10-, 50-, 100-, and 500-year rain flood events and shows both the present and future rainflood hydrology for the without local improvements condition. An inspection of the present condition data shows the 10-year flows do not exceed 800 cfs on Little Cottonwood and Mill Creeks. Mill Creek 10-year flows exceed 800 cfs for future conditions at Highland Drive. This reflects the effects of future land use conditions and storm drain improvements. On Big Cottonwood Creek the present condition flow just upstream of Station 3503 reaches 1180 cfs, then it is regulated to 500 cfs. Peak flows equal 800 cfs on Little Cottonwood Creek under future flow conditions.

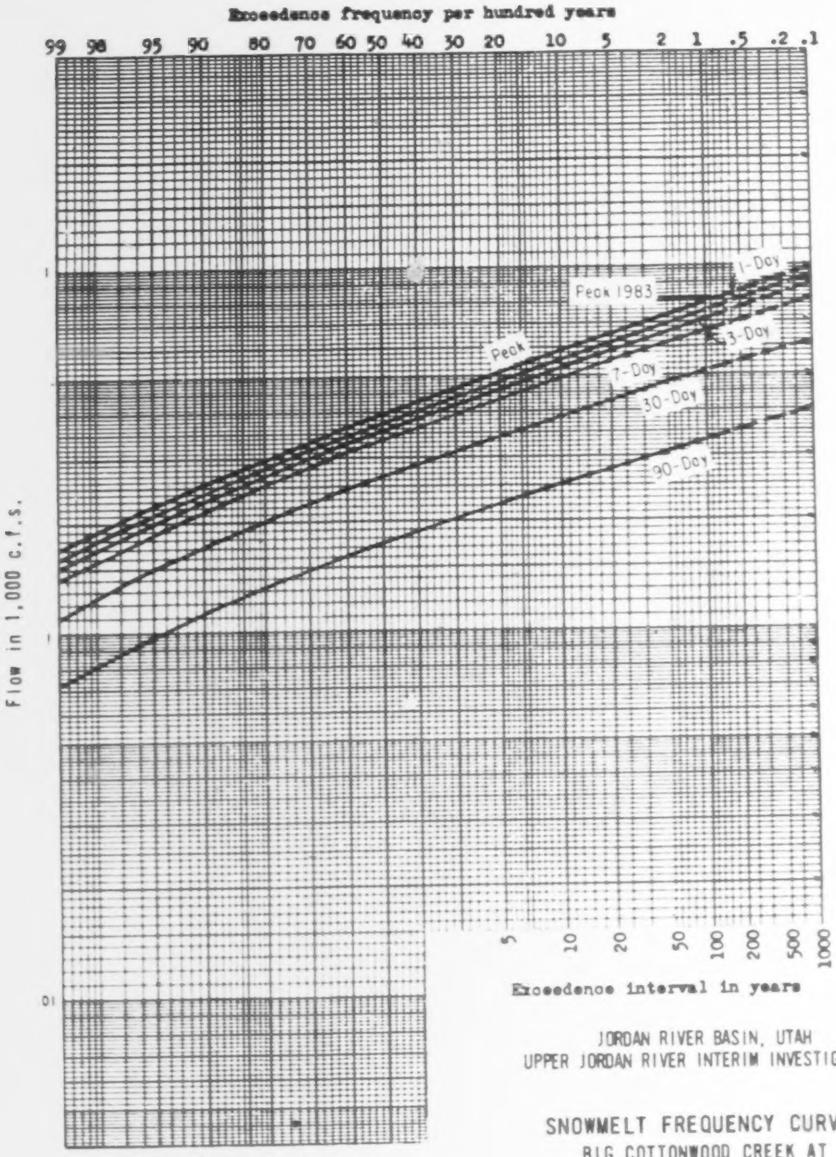


Drainage Area: 21.3 sq. mi.
Period of Analysis: 1899-1977

JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

SNOWMELT FREQUENCY CURVES
MILL CREEK AT CANYON
MOUTH USGS # 10170000

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985
FIGURE 2



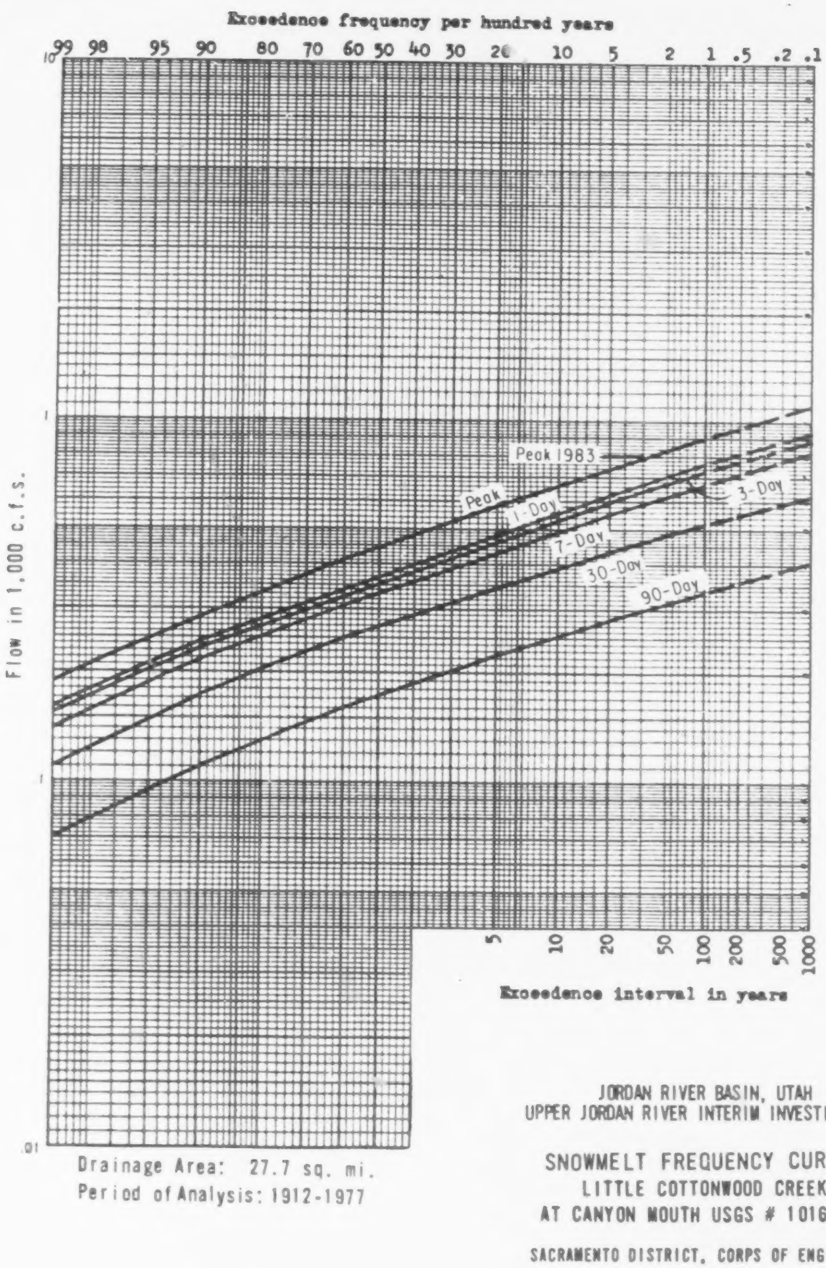
Drainage Area: 48.5 sq. mi.
Period of Analysis: 1901-1977

JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

SNOWMELT FREQUENCY CURVES
BIG COTTONWOOD CREEK AT
CANYON MOUTH USGS # 10168500

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985

FIGURE 3



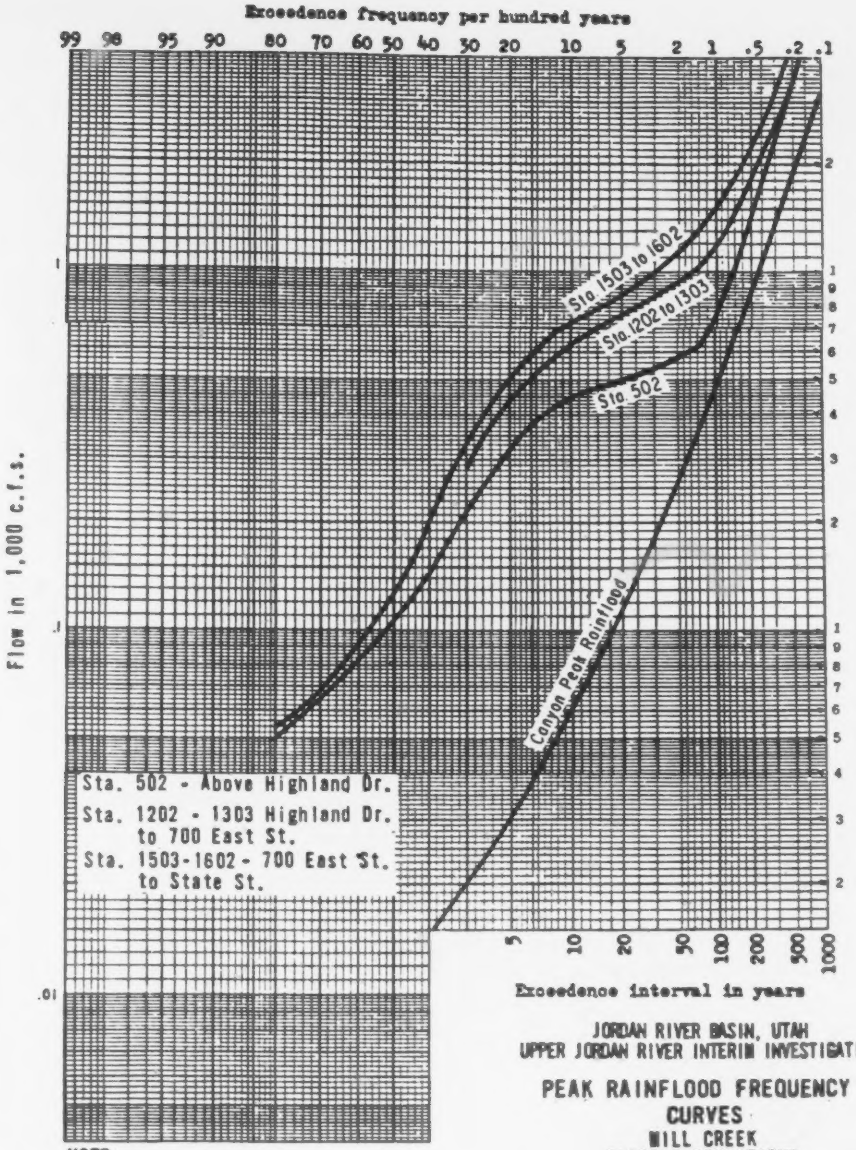
Drainage Area: 27.7 sq. mi.
Period of Analysis: 1912-1977

JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

SNOWMELT FREQUENCY CURVES
LITTLE COTTONWOOD CREEK
AT CANYON MOUTH USGS # 10167500

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985

FIGURE 4



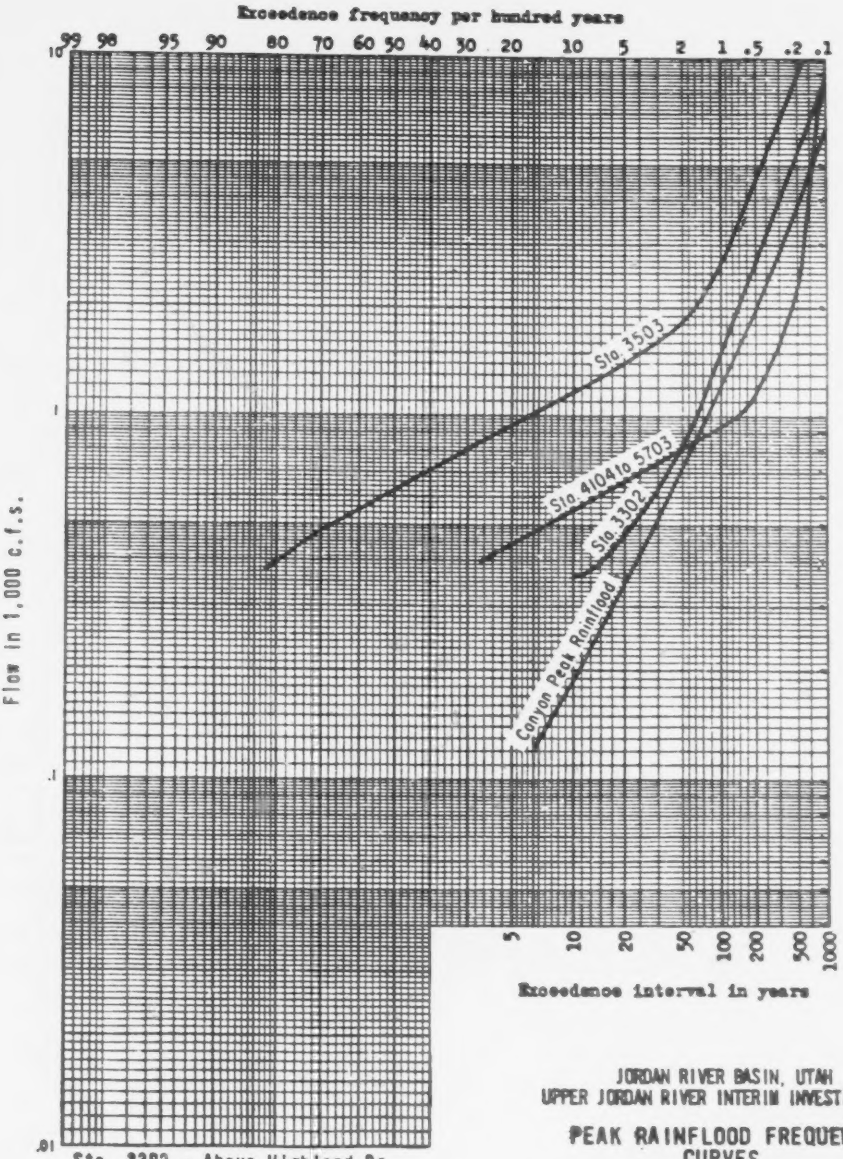
NOTE:
Major out of channel storage below Station 1602.

JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

PEAK RAINFLOOD FREQUENCY CURVES
MILL CREEK
PRESENT CONDITIONS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985
REVISED JANUARY 1988

FIGURE 5



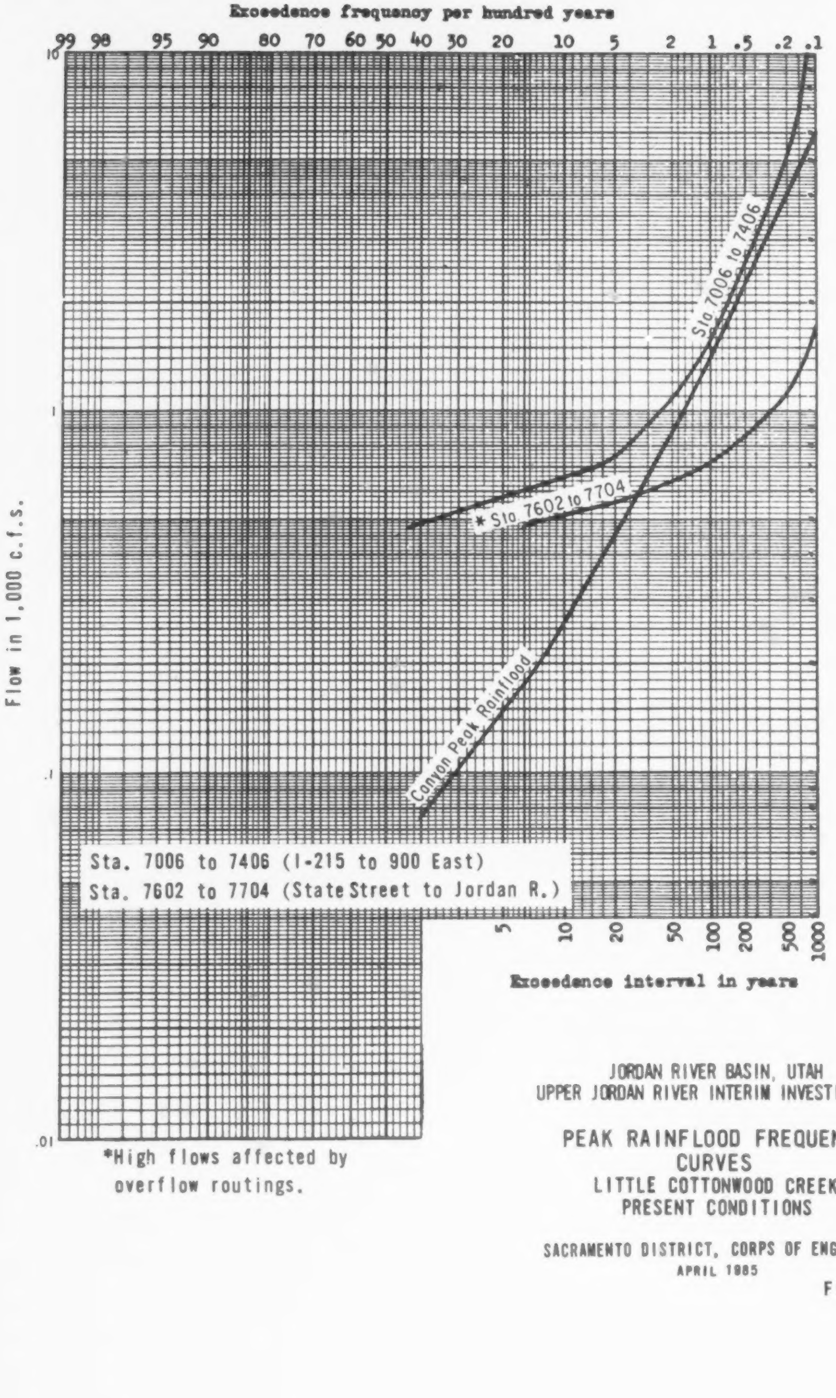
Sta. 3302 - Above Highland Dr.
Sta. 3503 - Highland Dr. to
Creekside Detention
Sta. 4104 to 5703 - 700 East St.
to State St.

JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

PEAK RAINFLOOD FREQUENCY
CURVES
BIG COTTONWOOD CREEK
PRESENT CONDITIONS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985

FIGURE 6



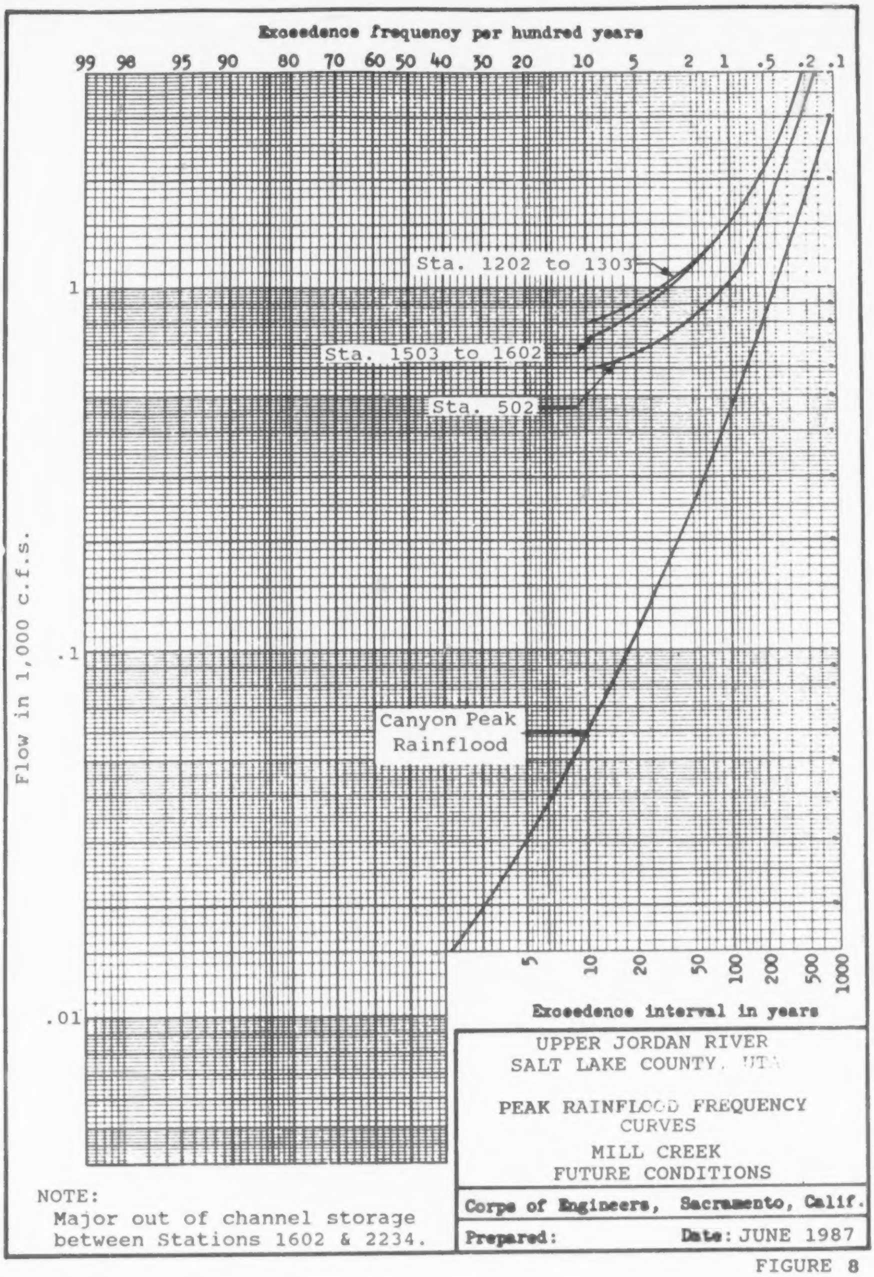
*High flows affected by overflow routings.

JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

PEAK RAINFLOOD FREQUENCY CURVES
LITTLE COTTONWOOD CREEK
PRESENT CONDITIONS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985

FIGURE 7



NOTE:
Major out of channel storage
between Stations 1602 & 2234.

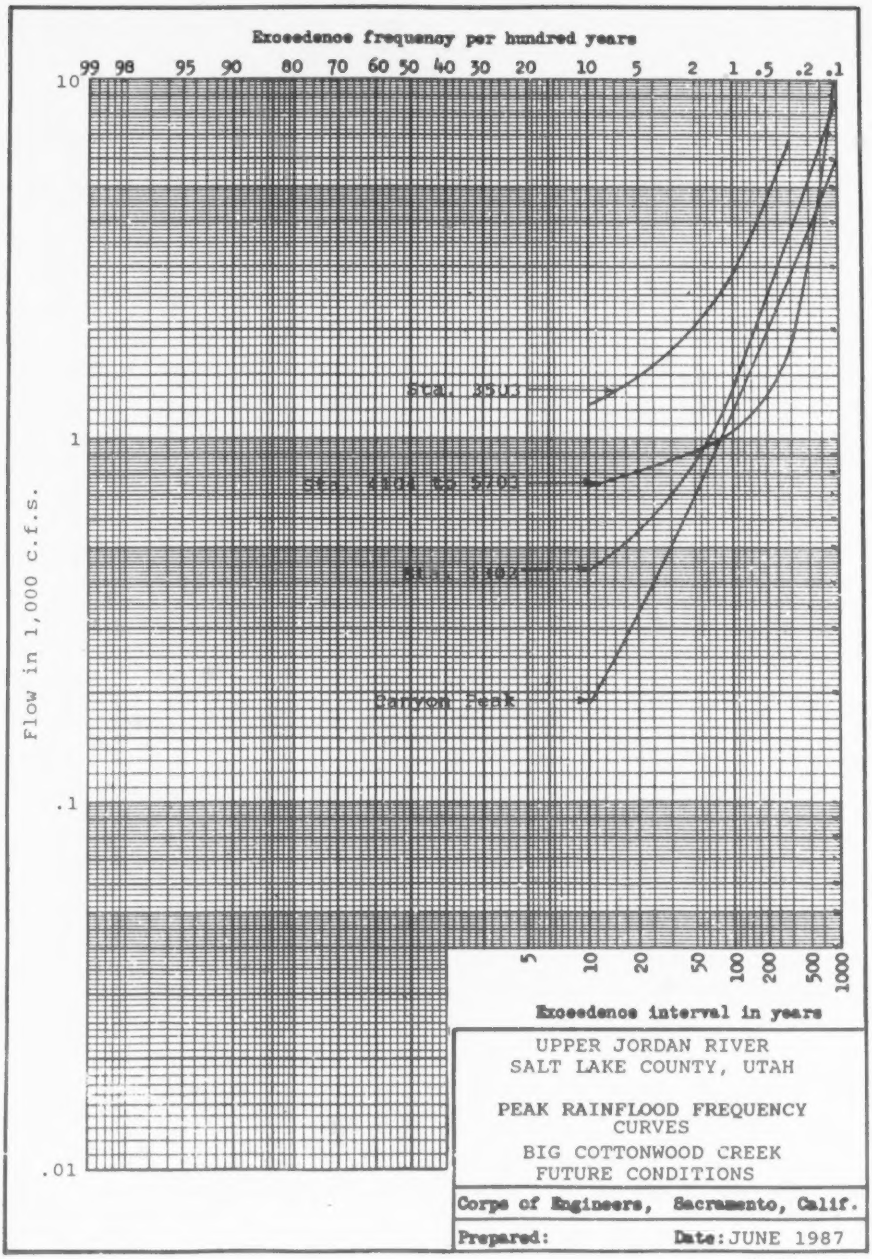
UPPER JORDAN RIVER
SALT LAKE COUNTY, UTAH

PEAK RAINFLOOD FREQUENCY
CURVES
MILL CREEK
FUTURE CONDITIONS

Corps of Engineers, Sacramento, Calif.

Prepared: **Date:** JUNE 1987

FIGURE 8



UPPER JORDAN RIVER
SALT LAKE COUNTY, UTAH

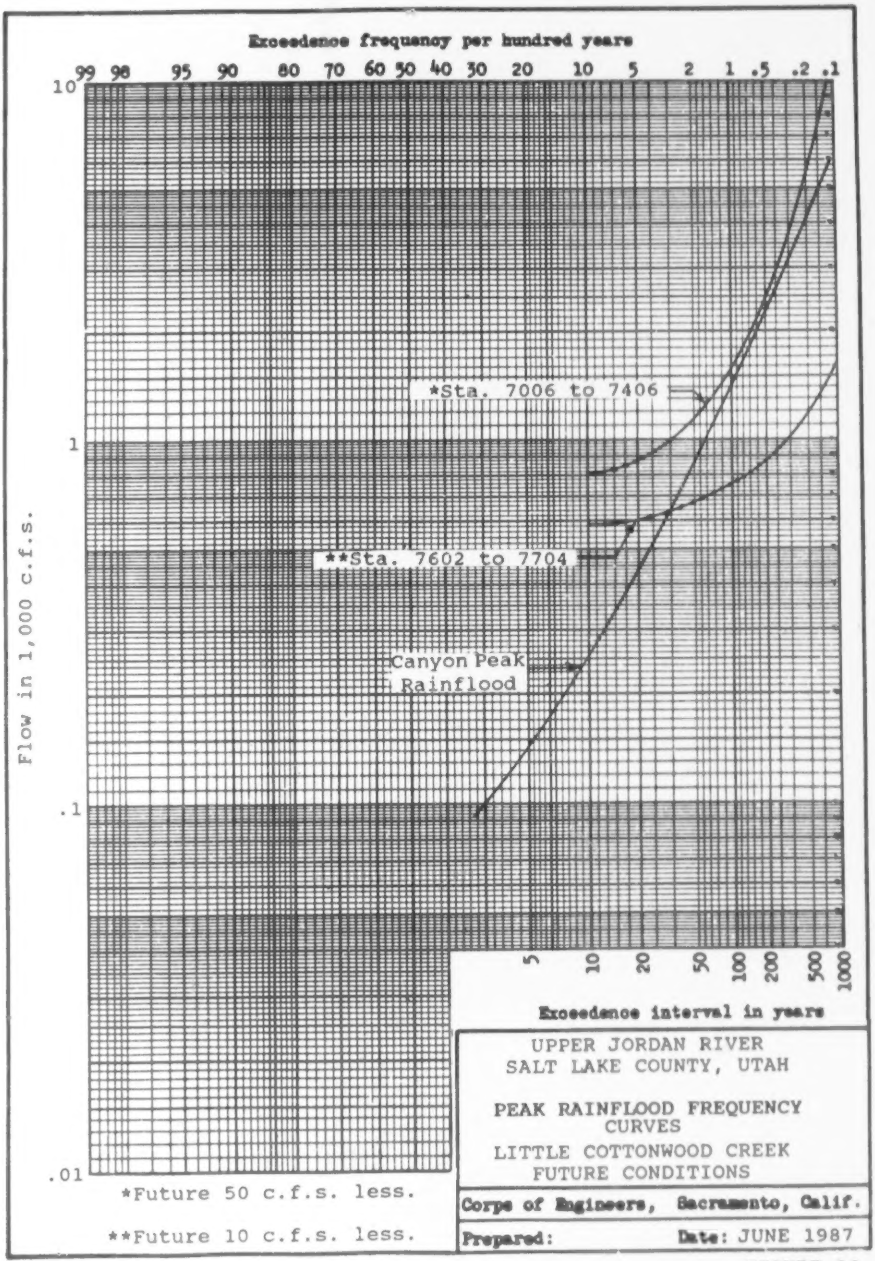
PEAK RAINFLOOD FREQUENCY CURVES

BIG COTTONWOOD CREEK
FUTURE CONDITIONS

Corps of Engineers, Sacramento, Calif.

Prepared: **Date:** JUNE 1987

FIGURE 9



UPPER JORDAN RIVER
SALT LAKE COUNTY, UTAH

PEAK RAINFLOOD FREQUENCY CURVES
LITTLE COTTONWOOD CREEK
FUTURE CONDITIONS

Corps of Engineers, Sacramento, Calif.

Prepared: **Date:** JUNE 1987

*Future 50 c.f.s. less.

**Future 10 c.f.s. less.

FIGURE 10

42-427 53

TABLE 5

PEAK RAINFLOOD FLOWS
(WITHOUT LOCAL IMPROVEMENT CONDITION)

Stream/ Index Sta.	Applicable reach/ Condition	Frequency			
		10-Yr.	50-Yr.	100-Yr.	500-Yr.
Mill Creek					
502	Above Highland Dr.				
	Present	460	580	750	3,500
	Future	600	830	1,050	3,500
1202-1303	Highland Dr. to 700 East St.				
	Present	650	920	1,180	3,500
	Future	810	1,150	1,500	4,500
1503-1602	700 East St. to State St.				
	Present	720	1,130	1,500	4,500
	Future	730	1,150	1,500	4,500
Big Cottonwood Creek					
3302	Above Highland Dr.				
	Present	360	820	1,400	5,200
	Future	440	880	1,400	5,200
3503	Highland Dr. to Creekside Det.				
	Present	1,180	1,820	2,650	9,000
	Future	1,240	1,050	2,900	9,000
4104-5703	1300 East St. to State St.				
	Present	560	850	940	2,600
	Future	730	940	1,100	3,200
Little Cottonwood Creek					
7006-7406	Above I-15 to 900 East St.				
	Present	660	1,080	1,550	5,200
	Future	800	1,120	1,550	5,200
7602-7704	900 East to Jordan R.				
	Present	520	630	730	1,150
	Future	560	660	740	1,150

HEC-1 studies were used not only to develop rainflood flow-frequency data for various levels of urbanization but also to analyze local improvements and potential Corps measures, as described hereafter.

ECONOMIC ANALYSIS

The feasibility of reducing flood damages along Mill Creek, Big Cottonwood Creek, Little Cottonwood Creek, and the Jordan River was examined in economic evaluations for the initial Upper Jordan River Interim Investigation. The assumptions for the benefit analysis were 1980 prices and conditions, a 100-year project life, and a 7-3/8 percent interest rate. The analysis included development of physical flood damages caused by inundation and the flood emergency losses or costs incurred in fighting or preparing for flooding. Damages were estimated for six general land use categories: residential, commercial, industrial, public, semipublic, and agricultural. Losses include damages to structures, contents, and property; improvements; roads and utilities; and other related improvements. Emergency losses include costs of evacuation and reoccupation, flood fighting and disaster relief, and other expenses. Intangible damages such as loss of life, impairment of health and living conditions, and other items not subject to monetary evaluation have not been included in the damage analysis.

The Flood Disaster Protection Act of 1973 (Public Law 93-234) provides opportunities for communities that have flood-prone areas to participate in the National Flood Insurance Program. Under the program, local government is required to adopt regulations requiring all new and replacement structures in the 100-year flood plain to have their first floor elevated to or above the 100-year flood elevation. The National Flood Insurance Program has been adopted in Salt Lake County, and, for purposes of economic evaluations, the first floor of all future development within the 100-year flood plain was assumed to be elevated to the level of the 100-year flood.

Flood damages and benefits were calculated using the Damage Computer Program. The program combines flow-frequency and flow-damage relationships to develop damage-frequency curves for without- and with-project improvements. A flood plain inventory was conducted to identify all damageable property within the flood plain shown on Plate 3. The model was updated during the study for price levels and incorporation of local improvements and associated hydrologic data changes, as described in the sections entitled Residual Flood Problems and Mill Creek Alternatives.

Measurement and Projection of Physical Flood Losses

Measurement and projection of flood damages are based on present and future land use characteristics and vulnerability to flooding. Land use categories and related acreages for the 500-year flood plain and for streams within the study area for 1980 and 1985 and projected through 2085 are summarized in Table 6.

TABLE 6

EXISTING AND FUTURE LAND USE IN THE 500-YEAR FLOOD PLAIN (ACRES)

Designation	1980	1985	Future				
			1995	2005	2015	2025	2035-2085
MILL CREEK							
Residential	405	418	447	467	486	507	531
Commercial	333	353	397	426	455	487	521
Industrial	53	58	68	73	78	83	88
Public	312	312	312	312	312	312	312
Agriculture[1]	1,561	1,523	1,440	1,386	1,333	1,275	1,212
Total Acreage	2,664						
BIG COTTONWOOD CREEK							
Residential	78	82	91	97	102	109	116
Commercial	75	77	81	85	88	91	91
Industrial	77	83	89	95	95	95	95
Public	16	18	20	22	23	23	23
Agriculture[1]	204	190	169	151	142	132	125
Total Acreage	450						
LITTLE COTTONWOOD CREEK							
Residential	113	117	125	130	136	142	149
Commercial	11	11	11	11	11	11	11
Industrial	-	-	-	-	-	-	-
Public	39	39	39	39	39	39	39
Agriculture[1]	521	517	509	504	498	492	485
Total Acreage	684						
UPPER JORDAN RIVER							
Residential	6						
Commercial	-		NO SIGNIFICANT CHANGE IN FLOOD PLAIN LAND USE PROJECTED				
Industrial	5						
Public	84						
Agriculture[1]	927						
Total Acreage	1,022						

---

[1] Includes vacant, native vegetation, fallow field, and stream channel.

Flood damages for future years included projecting the number and size of the physical units, estimating the existing and future values of units, and determining the damage susceptibility of those units. Field surveys identified the number and size of physical units in the 10-, 50-, 100- and 500-year flood plains for each land use category. For residential structures, the number of units were identified by aerial maps and field surveys from which foundation heights and susceptibility to flooding were also determined. Projections of future residential growth were based on local and regional population projections in addition to direct interview and land use plans. Projections of future commercial growth were based on the Salt Lake County District Development Plans and city and county zoning maps and ordinances. Future industrial growth was estimated by reviewing local land use plans, zoning maps, and ordinances. Projections for future public and semipublic facilities were based on local and regional population projections as well as direct interviews and land use plans. Population projections were obtained from the Salt Lake Area Transportation Study. The number of units estimated to be in the flood plain in 1980 and projections of future units through 2035, based on the above analysis, are presented in Table 7.

The values of existing properties in the flood plain were obtained from assessment rolls from the Salt Lake County Assessor's Office and were adjusted to market values consistent with information from realtors, public officials, and actual sales values, as available. Unit values of commercial, industrial, public, and agricultural properties were not increased over time. Increases in the total value of properties in the flood plain resulted from expansion of existing facilities and construction of new units. The value of residential contents was increased over time in conformance with affluence factor methodology described in the Water Resources Council's Principles and Guidelines. The OBERS regional growth rate for per capita income was used as the basis to increase the real value of residential contents in the future to account for the effects of affluence. The value of residential contents was projected at the per capita income growth rate to a maximum level of 75 percent of the value of the residential structure.

After the number of physical units and the value associated with each unit were determined, damage susceptibility relationships were established as a function of total value of each physical unit and the flood characteristics of the stream. Using the inventory data for present and future conditions for the various damage categories, flood damages were computed from flow-frequency, depth-damage, and damage-frequency relationships. Damage-frequency relationships were developed for individual damage categories, based on the type of structures, foundation heights, localized terrain, and applicable flood depths. Other factors considered in the flood damage analysis were velocity, duration, and debris content of floodwaters.

Depth-damage relationships were established as a percentage of the total value of damageable property or the probable loss expected for various flood depths. The relationships were derived from established curves supplemented by available historical information. Damage-flow relationships were estimated for selected flood frequencies, by inventorying developments, applying depth of flooding, and applying the appropriate depth-damage relationships for each damage category. Probable damages were determined for the 10-year, 50-year, 100-year, and 500-year flood events.

TABLE 7

EXISTING AND FUTURE DAMAGEABLE UNITS
(500-YEAR FLOOD PLAIN)

Designation	1980	1985	1995	2005	2015	2025	2035-2085
MILL CREEK							
Residential							
Single Family	1,309	1,340	1,406	1,450	1,494	1,543	1,596
Multiple	882	999	1,265	1,439	1,615	1,806	2,013
Mobile Homes	116	116	116	116	116	116	116
Commercial	396	419	472	507	542	580	621
Industrial	11	12	14	15	16	17	18
Public & Semipublic	25	25	25	25	25	25	25
BIG COTTONWOOD CREEK							
Residential							
Single Family	89	99	120	134	147	162	178
Multiple	384	421	505	560	616	676	742
Mobile Homes	133	133	133	133	133	133	133
Commercial	75	82	89	96	103	107	107
Industrial	30	33	36	39	39	39	39
Public & Semipublic	1	1	1	1	1	1	1
LITTLE COTTONWOOD CREEK							
Residential							
Single Family	368	386	428	454	482	512	544
Multiple	144	156	181	198	215	233	253
Mobile Homes							
Commercial	51	51	51	51	51	51	51
Industrial	-	-	-	-	-	-	-
Public & Semipublic	1	1	1	1	1	1	1
UPPER JORDAN RIVER							
Residential							
Single Family	22						
Multiple		NO SIGNIFICANT GROWTH PROJECTED					
Mobile Homes							
Commercial							
Industrial	1						
Public & Semipublic	2						

Flood Plain Property Values

The market value of damageable property occupying the 500-year flood plain, excluding land, roads, and bridges, was estimated to be about $639 million based on 1980 price levels. Damageable property values by land use category for streams within the study area are shown in Table 8. The reported values include only ground floor units and their contents since the flooding would not damage units above the first floor. About 41 percent of the total flood plain property value is contained in the residential categories (structure and contents).

TABLE 8

DAMAGEABLE PROPERTY VALUES 1/
500-YEAR FLOOD PLAIN
(1980 Conditions and Prices)

Damage Type	Mill Creek	Big Cottonwood Creek	Little Cottonwood Creek	Upper Jordan River
Single family Residential	$130,230,000	$12,230,000	$44,120,000	$2,330,000
Mobile Homes	4,710,000	5,670,000		
Multiple residential	37,880,000	15,860,000	10,900,000	
Commercial	262,040,000	20,010,000	30,140,000	
Industrial		42,980,000		6,200,000
Public facilities	9,710,000		2,940,000	1,000,000
TOTAL	$444,570,000	$96,750,000	$88,100,000	$9,530,000

1/ Structure and first floor content value only.

Flood Damage

Flood damages were developed for each stream by designated reach, initially for the present hydrologic flow-frequency data. The study area streams were divided into reaches based on homogeneous hydrologic and land use characteristics. The economic reaches and the associated hydrologic index stations are shown in the following tabulation.

ECONOMIC REACHES

Stream	Reach	Location	Hydrologic Index Stations
Mill Creek			
	1	Wasatch Blvd to Highland Drive	502-1
	2	Highland Drive to 700 East St.	1202-1303
	3	700 East St. to State St.	1503-1602
	4	State St. to Jordan River	1503-1602
Big Cottonwood Creek			
	1	Wasatch Blvd to 6200 South	3302
	2	6200 South St. to Highland Dr.	3503
	3a	Highland Dr. to Creekside Basin	3503
	3b	Creekside Basin to State St.	4104
	4	State Street to Jordan River	4104-5703
Little Cottonwood Creek			
	1	Wasatch Blvd to 6600 South St.	7006
	2	6600 South St. to 900 East	7006-7406
	3	900 East St. to State St.	7602-7704
	4	State Street to Jordan River	7602-7704
Jordan River			
	1	9000 South St. to Little Cottonwood Creek	
	2	Little Cottonwood Cr. to 2100 South St.	

Average annual flood damages are presented for the period 1985-2085, discounted at 7-3/8 percent. Summarized information relating to flood damages is displayed in Table 9 for the streams.

The 100-year flood along Mill Creek would affect a 1,065-acre urban flood prone area extending from Wasatch Boulevard to the Jordan River. For the 100-year event, floodflows would be from 1 to 2 feet deep over the majority of the flood plain, and velocities would range from 2 to 5 feet per second. The 100-year flood would cause an estimated $14.6 million in damage to the approximately 1,700 residential and commercial structures within the flood plain.

The 100-year urban flood plain of Big Cottonwood Creek encompasses 449 acres extending from Wasatch Boulevard downstream to the Jordan River. Flooding would affect about 310 structures for the 100-year event. Flood depths would be up to 4 feet, velocities would be 1 to 3 feet per second, and damages are estimated at over $3 million.

The Little Cottonwood Creek 100-year, 360-acre flood plain extends from Wasatch Boulevard to the Jordan River. For the 100-year flood, overbank flood depths of over 2 feet and velocity of 1 to 3 feet per second would occur. Damages are estimated at $2.8 million to about 70 residential structures, 60 multiple-unit dwellings, and 21 commercial establishments within the flood plain.

TABLE 9

SUMMARY OF AVERAGE ANNUAL FUTURE DAMAGES (1980 PRICES, 1985-2085 CONDITIONS, AND 7-3/8 PERCENT INTEREST RATE)

Stream	Reach	Average Annual Flood Damages - $1,000
Mill Creek	1	10
	2	499
	3	882
	4	320
TOTAL		1,711
Big Cottonwood Creek	1	3
	2	5
	3	446
	4	29
TOTAL		483
Little Cottonwood Creek	1	17
	2	47
	3	87
	4	43
TOTAL		194
Jordan River	1	12
	2	7
TOTAL		19

The Jordan River 100-year flood would cause an estimated $230,000 in damages in the 675-acre, 100-year flood plain between 9400 South Street and 2100 South Street. About 22 structures would be affected. Average annual damages are estimated at $19,000.

PLAN FORMULATION

The process of developing and evaluating plans to resolve problems and needs previously identified is discussed in this section. The process includes (1) establishing planning objectives, (2) developing, formulating, and evaluating criteria, (3) identifying management measures, (4) formulating and evaluating alternative plans, and (5) refining and selecting a plan for potential implementation.

PLANNING OBJECTIVES

The objective of Federal flood and water-related resources planning is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders, and other Federal planning requirements. Contributions to the national economic development are measured by the net value of the national output of goods and services that accrue to the project. Accordingly, the problems and opportunities previously discussed were evaluated in terms of planning objectives described herein and criteria described hereafter. Planning objectives are:

1. Reduce flood-related damages along Mill Creek, Big Cottonwood Creek, Little Cottonwood Creek, and Upper Jordan River.
2. Preserve and enhance, as practical, wildlife habitat, water quality, and environmental values, and provide recreation opportunities to meet current and future demands as opportunities are made available in meeting the flood control objective.
3. Incorporate water conservation measures to the extent practical and feasible as opportunities are made available in meeting the flood control objective.
4. Coordinate potential improvement plans with local governmental plans and projects.

FORMULATION AND EVALUATION CRITERIA

Flood and related water resources plans are to be formulated to reduce flood-related damages and take advantage of opportunities that occur at the national, State, and local levels in ways that contribute to the NED objectives. Additional consideration is given to environmental quality, regional economic development, and other social effects. The environmental quality (EQ) account displays nonmonetary effects on significant natural and cultural resources. The regional economic development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan. The other social effects (OSE) account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

Because of their broad nature, these objectives and accounts have been redefined in terms of criteria relating to the problems and opportunities being investigated. These criteria provide for an objective and consistent formulation and evaluation of all alternatives.

Technical Criteria

- Alternative plans should complement State, Salt Lake County, and other local flood control plans and projects involving the study area streams.

- Alternative plans should be consistent with provisions of the National Flood Insurance Program.

- The maximum level of protection that can be economically justified should be considered due to the high concentration of urban development.

- Where channel enlargement is necessary, efforts should be made to avoid disruption of significant natural features.

- The selected plan should not worsen conditions for floods exceeding project design without measures to compensate for effects.

- Federal participation in implementing plans to address urban water damage problems associated with a natural stream or modified natural waterway will be limited to stream reaches located downstream from the point where the flood discharge of such stream or waterway within an urban area is greater than 800 cubic feet per second (cfs) for the 10 percent flood (one chance in ten of being equaled or exceeded in any given year) under conditions expected to prevail during the period of analysis.

- Potential water conservation, recreation, water quality, and fish and wildlife preservation and enhancement measures compatible with the flood control and economically feasible should be considered.

- Potential associated functions should be incrementally justified.

- Associated functions should be compatible with and supported by non-Federal interests for sharing project costs and assuming operation and maintenance responsibilities.

Economic Criteria

- Benefits and costs should be expressed in comparable terms as fully as possible. Evaluations of alternatives should be based on the same price level, interest rate, and project life.

- Alternatives considered in detail should be "justified" in the sense that total beneficial effects are equal to or exceed the total adverse effects associated with the objectives.

- Project benefits should be based on analysis of conditions without and with a project, using methodology described in "Principles and Guidelines" and Corps of Engineers regulations.

- **The selected plan should provide maximum net benefits except where compelling level of protection, environmental, or other considerations clearly justify variation.**

Environmental Criteria

- Plans should be formulated to preserve and enhance the quality of the natural environment to the extent practicable, including fish and wildlife; riparian vegetation; and land, air, water, open space, and scenic and esthetic values.

- Detrimental environmental effects should be avoided where possible, and feasible mitigation for unavoidable effects should be included. To the extent possible, feasible mitigation should be confined to lands acquired for other project features.

- The relationship of the proposed action to local plans should be considered, and environmental impacts evaluated. Adverse environmental effects which cannot be avoided should be delineated and alternatives to such proposed action should be identified. The relationship between local short-term uses and the maintenance or enhancement of long-term productivity should be determined, and any irreversible and irretrievable commitments of resources involved if a proposed action were implemented should be identified.

- Plans should be formulated to preserve and enhance cultural resources values to the extent practicable. In the event that preservation is not feasible, any encountered resources must necessarily be evaluated and treated in accordance with the requirements of the National Historic Preservation Act of 1966, as amended (16 USC 470) and its implementing regulations contained to Title 36 Part 800 of the Code of Federal Regulations.

Socioeconomic Criteria

- Consideration should be given to safety, health, community cohesion, and social well-being.

- Displacement of people should be minimized.

- Effects on local income, employment, business and industrial activity, population distribution, and desirable community growth should be considered.

- General public acceptance of plans should be determined by coordination with interested Federal and non-Federal agencies, various groups, and individuals by means of public meetings, field inspections, informal meetings, letters, and other public involvement procedures.

- Plans should be workable within the constraints of present and potential governmental structure, function, relationships, and associations in the study area.

MANAGEMENT MEASURES

Many measures were identified and initially considered in meeting the planning objectives for flood control and in recognition of other associated problems and needs. The most viable management measures considered are described briefly below.

No Action

Under this alternative, no action would be taken by the Federal government to alleviate flood problems and conditions in the study area. No action would mean that floods occurring in the future similar to floods in the past would cause significant flood inundation damages to the Salt Lake City area, even with restrictions imposed on development in the flood plains. This measure is used as a basis for establishing without-project conditions and determining benefits and accomplishments of other measures.

Zoning and Insurance

Zoning includes flood plain regulations which restrict developments in floodway fringe areas and preclude structural developments in designated floodways. Insurance includes the option given private property owners to purchase flood insurance to cover existing developments against financial losses associated with flooding. Zoning and insurance are measures which have largely been adopted by local governmental entities and are not viable Federal flood control options. However, through development of flood plain maps and through Federal zoning regulations and policies, these local measures are supported.

Temporary Evacuation

This measure includes a monitoring and warning system to warn those within the flood plain of imminent flood threat and to determine possible evacuation of potentially affected areas. The measure was eliminated from further consideration primarily because there is insufficient time to monitor and identify an imminent flood threat and to effectively warn flood plain residents of cloudburst flooding.

Permanent Evacuation

This measure consists of purchasing lands and developments within the flood plain which are subject to serious flood threats. This measure was eliminated from further consideration because the cost of properties within the flood plain significantly exceeds potential flood damages.

Flood Proofing

Flood proofing includes constructing temporary or permanent closures and floodwalls or levees at developments or compatible clusters of developments within the flood plain. It may also consist of raising existing structures above flood limits or protecting damageable properties within the structure. Because of the type and amount of encroachment of urban development along streams in the study area, the cost to implement this measure would far exceed flood damage reduction benefits derived. Consequently, the use of this measure was limited to the more sparsely developed areas.

Reservoirs

This measure includes consideration of reservoirs for flood control and water conservation in the upstream portions of Mill, Big Cottonwood, and Little Cottonwood Creeks. None of the potential reservoir sites in the watershed areas are economically feasible for flood control because of high construction costs and limited potential to help control flooding in urbanized areas. Conservation storage in combination with flood control is not currently needed because available and planned water supplies will meet projected needs until about the year 2010.

Offstream Storage

This measure consists of diverting floodflows from the creeks to off-stream basins for temporary storage. Several such basins have been constructed by local interests. This measure was retained for further consideration.

Channel Improvement

This measure consists of increasing the flow carrying capacity of constricted stream reaches through vegetation, debris, and sediment removal; channel enlargement; floodwalls; and bridge replacement. Local interests have improved many reaches of the creeks. This measure was retained for further consideration.

Levees

This measure includes construction of levees along streams to contain floodflows. This measure was eliminated from further consideration primarily because only intermittent lands are available adjacent to streams for levee construction and right-of-way.

Parkway

This measure includes the incorporation of recreation trails along levees and streams, and the purchase of open areas, as available, to preserve the natural stream environment and to provide recreation opportunities. This measure was considered further in appropriate areas.

Several measures were eliminated from consideration because of lack of economic feasibility, significant environmental problems, or limited potential for providing solutions. Measures retained were used in the development of alternative plans. Potential management measures considered and those selected for further development are identified in Table 10.

TABLE 10

MANAGEMENT MEASURES EVALUATION

Management Measures	Selected for Further Consideration	Reason for Elimination
Nonstructural		
No Action	Yes	
Zoning & Insurance	Yes	
Temporary Evacuation	No	Insufficient warning time
Permanent Evacuation	No	Infeasible
Flood Proofing	Yes	
Structural Measures		
Upstream reservoirs	No	Limited potential solution
Offstream storage	Yes	
Channel improvement	Yes	
Levees	No	Infeasible
Parkway (Levees & Recreation)	Yes	

DEVELOPMENT OF ALTERNATIVES

Initial plan formulation and evaluation studies were completed in September 1981. Selected alternatives were further developed during 1982 and 1983. As a result of the September 1982 and June 1983 flood damages, local interests implemented mitigation measures and selected improvement consistent with available resources. In December 1983, a bond issue was passed for $33.5 million for restoration and capital improvements. In May 1984, local interests plans and projects were identified and Corps investigations were redirected to residual flood problems on Mill Creek. The plan formulation and evaluation of alternatives are summarized in this section for documentation purposes. Subsequent sections include descriptions of local interests flood control plans, residual flood problem analysis, and Mill Creek alternatives for potential Federal project consideration.

Alternative plans were initially developed by incorporating one or more management measures into a viable plan to resolve flood problems and to meet other needs. Alternatives were developed for urbanized reaches of each tributary and along the most highly developed reach of the Jordan River. These were subsequently refined by concentrating on the most critical problem areas and considering various levels of protection. Alternative plans initially developed and evaluated are identified on Table 11.

TABLE 11

ALTERNATIVES DEVELOPED FOR EACH STREAM

ALTERNATIVE	MILL CR.	BIG COTTONWOOD CREEK	LITTLE COTTONWOOD CREEK	JORDAN RIVER
NO ACTION	X	X	X	X
NONSTRUCTURAL	X	X	X	X
CHANNEL IMPROVEMENT	X	X	X	
DETENTION BASINS	X		X	
PARKWAY	X	X	X	X
CHANNEL IMPROVEMENT AND DETENTION BASIN	X		X	

Alternative plans were developed and analyzed for economic feasibility during the plan formulation and evaluation phase of the investigation. For those alternatives having economic feasibility, further evaluations were made. These are described, by stream, in the following paragraphs. Initial evaluations were based on October 1980 prices, an interest rate of 7-3/8 percent, and a project life of 100 years.

Mill Creek

Nonstructural flood proofing, channel improvement, and parkway alternatives were eliminated for lack of economic feasibility. The no action, detention basin, and detention basin-intermittent channel improvement alternatives were retained for further development.

No Action. - The no action alternative was considered as a basis for comparing alternatives.

Detention Basins. - The detention basin alternative was developed, incorporating two offstream detention basins (Scott Avenue and Hillview) with associated collection, diversion, and conveyance works. Both the 100- and 50-year levels of flood protection were analyzed, as they provide near maximum net benefits.

First costs for the 100- and 50-year levels of protection were about $12.2 and $10.8 million, respectively. The benefit-cost ratios were 1.2 and 1.3, respectively. Recreation facilities as an added increment of the Scott Avenue basin would have a benefit-cost ratio of 7.2 to 1.0 for both levels of protection.

Major features of the detention basin plan and associated recreation features for the two levels of development are shown in Table 12. Costs and benefits are summarized in Table 14.

TABLE 12

MILL CREEK
DETENTION BASIN ALTERNATIVE FEATURES

Feature	Location	Length (ft)	Capacity
	100-Year Level of Protection		
Collector Flume & 3 Bridge Replacements	Above Highland Drive to 1300 East St.	1,900	1,350 cfs
Diversion Dam and pipeline	Diversion at 1300 East St - Pipeline-Mill Creek to Hill-view Detention Basin	6,000	1,000 cfs
Hillview Detention	Above 900 East St. near 4100 South St.		110 AF
Grouted Rock Channel & 6 Bridge replacements	1100 East St. to below 900 East Street	1,720	730 cfs
Diversion Structure, Scott Ave. Detention, and Recreation Facilities	Below 900 East St. and above Scott Avenue		65 AF 9.5 Acres 160,000 Rec Days/Year

TABLE 12 (cont'd)

MILL CREEK
DETENTION BASIN ALTERNATIVE FEATURES

Feature	Location	Length (ft)	Capacity
	50-Year Level of Protection		
Collector Flume, Intake & 3 Bridge replacements	Above Highland Drive to 1300 East Street	1,900	1,130 cfs
Diversion Dam and Pipeline	Diversion at 1300 East St.- Pipeline-Mill Creek to Hillview Detention Basin	6,000	750 cfs
Hillview Detention	Above 900 East near 4100 South Street		85 AF
Grouted Rock Channel & 6 Bridge Replacements	1100 East St. to below 900 East St.	1,720	550 cfs
Diversion Structure, Scott Ave. Detention, and Recreation Facilities	Below 900 East St. and above Scott Avenue		65 AF 9.5 Acres 160,000 Rec Days/Year

Channel Improvement - Detention Basins. - The channel improvement-detention basin alternative features for 50-year level of flood protection are shown in Table 13.

First cost of this plan is about $18.6 million. The benefit-cost ratio is 1.01 to 1.0. Associated recreation facilities have a benefit-cost ratio of 7.2 to 1.0.

Summary. - Table 14 presents data pertinent to the most viable alternatives on Mill Creek. The detention basin and channel improvement-detention basin alternatives are economically feasible and best meet the planning objectives and technical criteria. The detention basin alternative is the most cost effective but is only partially effective in resolving the flood problem. The channel improvements are not incrementally justified as a last-added increment to the detention basin channel plan; however, this plan was advanced for further study due to strong local support and effectiveness in solving the flood problem.

TABLE 13

MILL CREEK
CHANNEL IMPROVEMENT-
DETENTION BASIN ALTERNATIVE FEATURES

Feature	Location	Length (ft)	Capacity
	50-year Level of Protection		
Collector Flume & 3 Bridge Replacements	Above Highland Drive to 1300 East St.	1,900	1,130 cfs
Diversion Dam and Pipeline (102" Diameter)	Diversion at 1300 East Street-Pipeline-Mill Creek to Hillview Detention Basin	6,000	1,000 cfs
Hillview Detention	Above 900 East Street Near 4100 South Street		110 AF
Grouted Rock Channel & 6 Bridge Replacements	1100 East Street to below 900 East Street	1,720	550 cfs
Diversion Structure & Scott Ave. Detention	Below 900 East Street and above Scott Avenue		65 AF
Recreation Facilities	Scott Ave Detention		160,000 Rec-Day/ Year
Flume	Scott Avenue to 3300 South Street	2,550	350 cfs
Grouted Rock Channel & 2 Bridge Replacements	3300 South Street to State Street	7,500	400 cfs
Invert Modification & 5 Bridge Replacements	State Street to below I-15	1,100	650 cfs

TABLE 14
MILL CREEK ALTERNATIVES EVALUATION

	NO ACTION	DETENTION BASINS		CHANNEL IMPROVEMENT/ DETENTION BASINS
PURPOSE	FC	FC and R		FC and R
LOCATION	Wasatch Blvd to Jordan R (5 miles)	Highland Dr to I-15 (4 miles)		Highland Drive to I-15 (4 miles)
PRIMARY FEATURES	No Federal Action	Flume, 1300 East diversion, Hillview det (110 & 85AF), Scott Ave det basin - 65AF, assoc channel improvement & bridge modification		Flume, 1300 East div & Hillview det (110AF), Scott Ave det (45AF) & collection system. Channel invert modification & enlargement
ACCOMPLISHMENTS	None	Flood Control		Flood Control
		100-Yr	50-Yr	50-Yr
FIRST COST	NA	$12,185,000 (FC) $ 400,000 (R)	$10,780,000 1/ (FC) $ 400,000 (R)	$18,200,000 1/ $400,000
ANNUAL COST 2/	NA	$ 950,000 (FC) $ 90,000 (R)	$ 840,000 1/ (FC) $ 90,000 (R)	$1,388,000 1/ $90,000
ANNUAL BENEFIT	NA	$ 1,862,000	$ 1,774,000	$2,073,000
FLOOD CONTROL	NA	($ 1,200,000)	($ 1,112,000)	($1,396,000)
RECREATION	NA	($ 650,000)	($ 650,000)	($650,000)
BRIDGE REPLACEMENT	NA	($ 12,000)	($ 12,000)	($27,000)
NET BENEFITS	NA	$ 250,000 (FC) $ 830,000 (FC&R)	$ 272,000 (FC) $ 844,000 (FC&R)	$ 8,000 (FC) $ 595,000 (FC&R)
COMPLETENESS	NA	Yes		Yes
EFFECTIVENESS	NA	Partially		Yes
EFFICIENCY	NA	Yes		Yes
ACCEPTABILITY	NA	Yes		Yes
FURTHER CONSIDERATION	Yes	Yes		Yes

FC - Flood Control
R - Recreation

1/ Hillview Detention costs associated with Mill Creek are based on an incremental basis assuming a basic basin associated with Big Cottonwood Creek.
2/ October 1980 price level, 7-3/8 percent interest rate

Big Cottonwood Creek

Alternatives eliminated due to lack of economic feasibility include the nonstructural flood proofing and the parkway plans. The no action and intermittent channel improvement alternatives for 50- and 100-year flood control were retained for further study.

No Action. - The no action alternative was considered further as a basis for comparing alternatives.

Intermittent Channel Improvement. - The 50- and 100-year intermittent channel improvement plans were studied for the reach extending from Highland Drive to State Street. High levels of protection were considered but were determined to be infeasible and were not pursued beyond preliminary analysis. Major features are described in the tabulation below.

BIG COTTONWOOD CREEK ALTERNATIVES

	Location	Length (feet)	Capacity (cfs)
	50-Year Level of Protection		
Grouted Rock Channel	Highland Drive to existing Creekside Detention Basin	2,000	1,310
Grouted Rock Channel	2,600 feet above 4500 South St. to State St.	5,750	810-860
Bridge Modifications	Creekside & 4500 South Street		
	100-Year Level of Protection		
Grouted Rock Channel	Highland Drive to existing Creekside Detention Basin	2,000	1,500
Flume	2,600 feet above 4500 South St. to State St.	5,750	970-1,110
Bridge Modifications	Creekside, 4500 South St., & Doreen Street		

First cost of the 50-year protection alternative is estimated at $3.8 million, and the benefit-cost ratio is 1.1 to 1. The 100-year protection alternative has an estimated first cost of about $6.1 million. The benefit-cost ratio is 0.8 to 1.

Summary. Only the Intermittent Channel Improvement 50-year alternative was economically feasible and satisfied the planning objectives and technical criteria. Both alternatives are evaluated in Table 15.

TABLE 15

BIG COTTONWOOD CREEK ALTERNATIVES EVALUATION

	INTERMITTENT CHANNEL IMPROVEMENTS	
	50-Year	100-Year
PURPOSE	FC	FC
LOCATION	Highland Drive to State Street	Highland Drive to State Street
PRIMARY FEATURES	Grouted rock channel - 7,750 feet Two bridge modifications flood plain management measures	Flume - 5,750 feet; grouted rock channel - 2,000 feet; and three bridge modifications
ACCOMPLISHMENTS	50-Yr Flood Control	100-Yr Flood Control
FIRST COST	$3,790,000	$6,085,000
ANNUAL COST	$310,000	$460,000
ANNUAL BENEFIT	$340,000	$352,000
NET BENEFIT	$30,000	-$108,000
COMPLETENESS	Yes	Yes
EFFECTIVENESS	Yes	Yes
EFFICIENCY	Yes	No
ACCEPTABILITY	Yes	No
FURTHER CONSIDERATION	Yes	No

Little Cottonwood Creek

The Little Cottonwood Creek alternatives initially identified and evaluated are shown in Table 16. Alternatives eliminated due to lack of economic feasibility include the nonstructural, channel improvement, detention basin, and parkway plans.

The detention basin-channel improvement alternative was developed to provide protection along the 4.7-mile reach of Little Cottonwood Creek extending from 6600 South Street to the Jordan River. Major features included a 60 acre-foot detention basin at the Wheeler Farm site; 250 feet of flume above 900 East Street; and modification to the headwall of the bridge at 900 East Street. In addition, local interests would accomplish flood plain zoning, other bridge modifications as replacement is required, and flood proofing. Because Salt Lake County owns the land for the Wheeler Farm regional park, the recreation development was assumed as a preproject condition and has been planned to accommodate a detention basin. Land costs for flood control were therefore limited to costs for the detention dam and appurtenant facilities. With this alternative, flood protection would vary from 100-year below the potential Wheeler Farm basin to 20-year in downstream reaches. Costs are estimated at $1.45 million, and the benefit-cost ratio is 0.99 to 1.

Little Cottonwood Creek flood control measures were economically infeasible. Local interests developed the Wheeler Farm for historic preservation, recreation, and flood control purposes.

TABLE 16

LITTLE COTTONWOOD CREEK ALTERNATIVES EVALUATION

	NO ACTION	DETENTION BASIN-CHANNEL IMPROVEMENT
PURPOSE	FC	FC
LOCATION	Wasatch Blvd to Jordan R	6600 South St. to Jordan River - 4.7 miles
PRIMARY FEATURES	No Federal Action	Wheeler Farm Det 60 AF (Flood Easement) 250 ft channel improvement above 900 East, Non-Federal flood plain zoning, bridge mod and flood proofing
ACCOMPLISHMENTS	NA	100- to 20-Yr Flood Control
FIRST COST	NA	$1,450,000
ANNUAL COST	NA	$111,000
ANNUAL BENEFIT	NA	$112,000
B/C RATIO	NA	0.99

TABLE 16 (cont'd)

LITTLE COTTONWOOD CREEK ALTERNATIVES EVALUATION

	NO ACTION	DETENTION BASIN-CHANNEL IMPROVEMENT
COMPLETENESS	NA	Yes
EFFECTIVENESS	NA	Partially
EFFICIENCY	NA	Yes
ACCEPTABILITY	NA	Yes

Because local interests plan to expedite the economical alternatives, further study on Little Cottonwood Creek is not warranted.

Jordan River

Jordan River alternative plans considered are shown on Table 17.

Alternative plans were initially considered for the reach of the Jordan River from about 9400 South Street downstream to 2100 South Street, thus concentrating on the reach having the best potential for feasible flood protection. From an initial evaluation of the no action, nonstructural, and parkway alternatives, it was concluded that, because of the limited development in the Jordan River flood plain, single-purpose flood control features are not justified at this time.

LOCAL INTERESTS FLOOD CONTROL PLANS

During the plan formulation phase of the investigation, Salt Lake County flood control plans consisted of a management plan, including maps showing existing and proposed storm drains and detention basins associated with Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek. The plan served as a framework plan, but each major component was subject to reanalysis prior to implementation. Subsequently, the HEC-1N model developed for this investigation was adopted by local government as a basis for analysis and further development of flood control plans.

TABLE 17

UPPER JORDAN RIVER ALTERNATIVES EVALUATION

	NONSTRUCTURAL	PARKWAY
PURPOSE	FC	FC and R
LOCATION	9400 South to 2100 South Street	Little Cottonwood Creek to 2100 South Street
PRIMARY FEATURES	Bridge Mod (3) flood proofing existing structures (22) zoning & regulation	R/W acq 4.7 mi, 308 Acres - 25,000 feet of trail, 3 bridge adits, & 2 footbridges
ACCOMPLISHMENTS	100-Yr Flood Protection	100-Yr Flood-plain Acquisition & Recreation Trail
FIRST COST	$374,000	$15,500,000
FLOOD CONTROL	($374,000)	($13,800,000)
RECREATION	-	($ 1,700,000)
ANNUAL COST	$30,000	$1,275,000
FLOOD CONTROL	($30,000)	($1,040,000)
RECREATION	-	($ 235,000)
ANNUAL BENEFIT	$19,000	$1,355,000
FLOOD CONTROL	($19,000)	($7,000)
RECREATION	-	($1,348,000)
NET BENEFITS	-$11,000	+$80,000
FLOOD CONTROL	(-$11,000)	(-$1,033,000)
RECREATION	-	($1,113,000)
COMPLETENESS	Yes	Yes
EFFECTIVENESS	Partially	Yes
EFFICIENCY	No	No
ACCEPTABILITY	No	No
FURTHER CONSIDERATION	No	No

Because of the magnitude and damages of the September 1982 rain flood and the 1983 and 1984 snowmelt floods, local governments expanded and expedited mitigation measures and implemented flood control improvements.

Salt Lake County qualified for Federal Disaster Assistance in 1983 and again in 1984. FEMA funds covered 75 percent of the restoration costs associated with public facilities and other measures required to protect the general health and safety of the public. The State of Utah contributed 12.5 percent of repair and restoration costs. The remaining 12.5 percent was assumed by Salt Lake County, which used $11.5 million provided through a bond election in December 1983. The bond issue also included $22 million in capital improvement funds to accelerate flood control measures, including several measures developed during the plan formulation stage of this investigation.

By letter of 2 May 1984, Salt Lake County Flood Control and Water Quality Division outlined its plans for studies and projects within the Upper Jordan River study area. Capital improvements implemented or planned for implementation during 1984 to 1986 by Salt Lake County within the study area are listed in Table 18 and shown on Plate 5, Sheets 1 to 3.

The Flood Control Division requested the Corps to complete the Mill Creek portion of the investigation and to consider reevaluating the Jordan River system from Utah Lake to the Great Salt Lake. Subsequently, the Utah Lake - Jordan River - Great Salt Lake management was studied by a consulting firm with funds appropriated by the Utah State Legislature.

The study included a Phase I, Utah Lake-Jordan River Flood Management Program. The Corps participated, primarily as a resource agency, in providing data from previous studies and in reviewing the report. The Phase I report was completed in October 1984. Subsequently, the Phase II Engineering Design was completed. In December 1984 bids were received to implement the management plan, although funding was not secured at that time. During the 45-day State Legislative Session in 1985, $12.3 million was appropriated to fully fund the Utah Lake-Jordan River Management Plan. Features of the project include modifying the outlet of Utah Lake, dredging the Jordan River from Utah Lake to the Jordan Narrows, replacing and upgrading diversion structures in Salt Lake County to withstand increased riverflows, and stabilizing banks at critical locations in Salt Lake County. The project was constructed during the period May to December 1985.

In the Mill Creek drainage basin, Salt Lake County completed construction of the 50 acre-foot Scott Avenue Detention Basin in 1986. The basin is located offstream near Mill Creek and between 900 and 700 East Streets, as shown on Plate 5, sheet 1 of 3. Flows in excess of 200 cfs enter the basin over a side channel weir. Downstream bypass is controlled by an automated radial gate. The basin is surrounded by levees and floodwalls to contain the diverted flow. The levees and floodwalls also serve to divert overland flow around the basin. The basin is designed such that as capacity is approached, the stage of water within the basin precludes additional inflow, and surplus flows are forced to proceed down Mill Creek. This design eliminates the need for a spillway. Releases from the basin are regulated into an underground conduit which discharges back into Mill Creek as available stream capacity dictates.

TABLE 18

LOCALLY IMPLEMENTED RESTORATION AND CAPITAL IMPROVEMENTS

STREAM AND REACH	IMPROVEMENT MEASURES	CONSTRUCTION YEAR
MILL CREEK		
Wasatch Blvd to 1300 East	Intermittent channel enlargement, gabion bank protection, and drop structures. New culvert at Mill Creek Way and Canyon Way. Design capacity 600-790 cfs.	1984
1100 East to 900 East St.	About 1,700 feet of channel enlargement including grouted rock channel and concrete flume. New bridges at 1100 East Street, Carolyn Street, Christine Street, and 900 East Street. Design capacity 540 cfs.	1984
900 East to Scott Avenue	Scott Avenue Detention Basin, 51 acre-feet.	1985-86
700 East Street to 3300 South Street	Construction of about 400 feet of new channel. Design capacity 400 cfs.	1984
550 East Street	Detention basin, 11 acre-feet.	1986
MILL CREEK		
500 East Street to Main Street	New bridges or culverts at State Street, about 80 East, and Main Street. Intermittent channel improvements. Design capacity 632 to 800 cfs.	
Main St. to West Temple St.	Remove railroad culvert.	1984-85
300 West St.	Additional box culvert. Design capacity 700 cfs.	1984
Railroad Yards to Jordan River	Channel improvement about 3,500 ft., 900 West St. bridge replacement. Design capacity 900 cfs.	1986
BIG COTTONWOOD CREEK		
Wasatch Boulevard to Highland Drive	Intermittent channel improvements including widening, gabions, grouted rock, and riprap.	1984

TABLE 18 (cont'd)

LOCALLY IMPLEMENTED RESTORATION AND CAPITAL IMPROVEMENTS

STREAM AND REACH	IMPROVEMENT MEASURES	CONSTRUCTION YEAR
	Replacement bridges near 5900 South and 5700 South. Spencer detention basin near 3100 East. Design capacity 815 cfs near Wasatch Boulevard to 1,335 cfs near Highland Drive.	
Highland Drive to Creekside	Channel improvements including enlargement, gabions, and riprap. New bridges at Highland Circle and Creekside Drive. Design capacity 1,415 cfs.	1984
Creekside Detention Basin	Modification of radial outlet gate.	1984
Creekside Detention Basin to 1300 East St.	Channel improvement including gabions and riprap. Design capacity 760 cfs.	1984-85
1300 East St. to 4500 South St.	Intermittent bank stabilization and channel improvement including rock walls, gabions, and berms. Design capacity 910 cfs at upper end to 1,230 cfs at 4500 South Street	1984-85
BIG COTTONWOOD CREEK		
4500 South St. to State St.	Channel improvement, 2,900 feet, including concrete walls, gabions, berms, and a new bridge at Doreen St. Design capacity 1,230 cfs.	1985
LITTLE COTTONWOOD CREEK		
Willow Creek Country Club	Gabion channel through the golf course. Design capacity 1,000 cfs.	1984
Creek Road to 1300 East St.	Intermittent bank stabilization. Design capacity 1,000 cfs.	1984-85
1300 East St. to 6600 South St.	Improved channel near 1300 East. Design capacity, 1,400 cfs. Flume over I-215. Design capacity 1,100 to 1,300 cfs. About 4,800 feet of channel improvement.	1984-85

TABLE 18 (cont'd)

LOCALLY IMPLEMENTED RESTORATION AND CAPITAL IMPROVEMENTS

STREAM AND REACH	IMPROVEMENT MEASURES	CONSTRUCTION YEAR
6600 South St. to Wheeler Farm	Improved channel 400-foot length Design capacity 1,300 cfs. Replace 6600 South Street bridge and downstream canal crossings	1984
Wheeler Farm (about 6400 South)	Wheeler Farm Detention Basin 85 acre-feet.	1985
Wheeler Farm to 900 East St.	Intermittent bank stabilization, improvement, and extension of 900 East Street Bridge. Design capacity 1,300 cfs.	1984
5600 South St. to 5300 South St.	Gabion channel lining, 2,500 ft. Design capacity 900 cfs. Additional box culvert at 5300 South Street. Capacity 1,200 cfs.	1984-85
5300 South St. to State St.	Channel improvement through Murray Park, 4,500 ft. Design capacity 885 cfs. New bridge at State St.- Design capacity 900 cfs.	1984
LITTLE COTTONWOOD CREEK		
500 West St. to Jordan River	Channel widening and dredging about 1,800 ft. reach. Design capacity 900 cfs.	1984
JORDAN RIVER		
9000 South St. to Mill Creek	About 10,000 ft. of emergency levees constructed adjacent to Jordan River in various locations in the reach.	1983-84
	Bank protection measures near 3900, 4500, and 4800 South Streets.	1985

Salt Lake County originally planned to complete construction of the offstream Hillview Detention Basin by July 1987. However, budget constraints and cost-sharing obligations for the Little Dell Lake project have forced the County to postpone construction of the Hillview Detention Basin until the early 1990's.

The Hillview Detention Basin is located in a natural depression between Mill Creek and Big Cottonwood Creek and between 900 and 1100 East Streets, as shown on Sheet 1 of 3, Plate 5. The basin is under development by local government as an integral part of a local storm drainage system referred to as the I-9 Ditch system. The I-9 Ditch drainage area is shown on Plate 16. Because the proposed plan of improvement would cause some Mill Creek water to be diverted and temporarily held in the adjacent I-9 Ditch drainage basin, a thorough description of the I-9 Ditch drainage area is presented below.

Salt Lake County has definite plans to construct the Hillview and Upper detention basins and make other drainage improvements to the I-9 Ditch system. The County also has the financial ability to undertake this work. The County has a 3 mill tax which raises funds for flood control and drainage improvements. Revenues are about $7.5 million per year, with about one-third for existing facilities and about two-thirds for new construction. Currently, tax revenues are being used to pay off a $33.5 million bond used to construct flood control and drainage facilities along a number of streams following floods of 1982, 1983, and 1984. The County plans to pay off the bond in 1991. Construction of the Hillview and Upper basin, collector systems, and other improvements along the I-9 Ditch will take place in 1992 and 1993. Lands for the Hillview basin already have been acquired, and the Upper basin will be located in an existing County park. Construction costs of the Hillview basin are about $410,000 at 1987 prices. The Federal plan of improvement would be compatible with the improvements proposed by Salt Lake County.

The I-9 Ditch begins at approximately 4700 South and 1700 East Streets. The initial flow comes from low-lying marshy property where the water table is within 2 feet of the surface. The ditch's origin is in Salt Lake County-owned property. The ditch has an approximate flow of 1 to 2 cfs by the time it crosses 1300 East Street.

The I-9 Ditch drainage area lends itself to three separate study reaches or subareas which have been designated the Upper, Central, and Lower Drainage Areas, as shown on Plate 16. The Upper Drainage Area is east of the Big Ditch and would have its outfall into the proposed Upper Detention Basin. The Central Drainage Area includes the natural drainage area between the Upper Detention Basin and the proposed Hillview Detention Basin. The Lower Drainage Area follows the I-9 Ditch from the Hillview Basin downstream to its discharge point at Big Cottonwood Creek. Each drainage area has its own drainage characteris- tics with its own outfall destination. The three drainage areas comprise approximately 2,400 acres.

The I-9 Ditch drainage area varies from relatively flat, approximately 1 percent slopes, in the Lower and Central Drainage Areas to fairly steep, 4 to 5 percent slopes, in the Upper Area. The topography ranges from elevation 4,260 to 4,550. The soils in the I-9 Ditch drainage area consist of the Bingham-Parleys association and are generally classified as well-drained soils on high lake terraces.

The ground water table exists at relatively shallow depths in the Central and Lower Drainage Areas and ranges from 1 to 4 feet at the proposed detention basin sites. The high water table which approaches the ground surface decreases infiltration rates. The base flow in the I-9 Ditch is attributable to ground water except for some irrigation return flows.

In the past 130 years the I-9 drainage area has been transformed from sagebrush covered valley floor to irrigated farmland and pasture, and then to suburbs of Salt Lake City and Murray. The present drainage system has been significantly impacted by each of these three phases.

The natural drainage system that existed before the pioneer settlers came consisted of a ditch that flowed from the area of Cottonwood Mall to the Jordan River. This ditch was fed from springs and high ground water in various low spots in the drainage area. Springs existed on the Stonehedge Apartments property at 500 East Street, the Cottonwood Creekside Park area, and above 1300 East Street along 4500 South Street. All this water flowed westerly, following the contour of the land, to the Jordan River.

After the pioneers arrived, much of the area was farmed. Five irrigation ditches were dug to serve the water needs of the farmers. These include the Big Cottonwood Upper Canal, Salt Lake Jordan Canal, Big Cottonwood Lower Ditch, Big Ditch (main line and the Miller's extension), and the Hill Ditch irrigation canal. These canals raised the water table in the area and also picked up some storm runoff. The first three ditches flow through and leave the drainage area. However, tailwater from the Big Ditch and Hill Ditch eventually ends up in the I-9 Ditch.

After World War II, the drainage area was gradually developed into housing and some commercial developments. The Upper Drainage area is almost completely developed, while the Central and Lower Drainage Areas are each about 75 percent developed.

The early development took place with little regard for storm drainage. Curbs and gutters were rarely installed, and most areas allowed storm water to just percolate into the ground. In the mid-1960's, as Salt Lake City grew, interest was generated in controlling storm water and preventing flooding. Some pipe systems were installed, and some of the percolating areas were supplied with outlets. Since that time, Salt Lake County has begun an extensive flood control program and has allocated millions of dollars to flood control and water quality improvements.

The present trend in land use within the area is two-fold: first, gradual decrease in farmland and the subsequent abandonment of the need for the irrigation canals to convey irrigation water; and second, construction of commercial centers, high density condominiums, and apartments. Future drainage conditions will depend on what use is made of the old irrigation canals and restrictions made on new developments.

The Upper Drainage Area existing drainage facilities are shown on Plate 16. There are three irrigation canals in the upper area, and they are all currently involved in draining water from the area. The Big Cottonwood Upper Canal is controlled by Salt Lake City and collects storm water from the area between the canal and 2300 East Street. Presently, this water is carried north out of the drainage area to Mill Creek.

The Salt Lake Jordan Canal is owned by Salt Lake City and picks up storm runoff as it passes through the area. Some of this water is released at an overflow structure at 3900 South Street.

The Big Cottonwood Lower Ditch also picks up storm water as it passes through the drainage area. This water is presently carried out of the area except during high intensity storms when flooding problems have occurred at numerous locations. This canal is currently privately owned, but negotiations with Salt Lake County Flood Control are underway for a transfer of ownership.

Two major storm drain pipe systems exist in the Upper Drainage Area. One is under Holladay Boulevard and carries water to the Salt Lake Jordan Canal. The second pipe system picks up water in the area of Albright Drive and 4400 South. Water is carried south to 4500 South then west to Arcadia Lane. The system then goes south to 4800 South and connects to a main line which carries runoff to Big Cottonwood Creek. This system reduces the I-9 drainage area by carrying water out of the Upper Drainage Area.

All other drainage in this area consists of surface flows and small pipe flows which enter the existing canals.

The Central Drainage Area drainage facilities consist of one irrigation canal, pipe systems, and the I-9 Ditch. These systems carry water from springs, ground water, and storm runoff. The only irrigation canal is the Big Ditch irrigation canal, which is privately owned. It splits at Highland Drive and Murray-Holladay Road into two branches. The split is known as Miller's extension of the Big Ditch, and it goes west on Murray-Holladay Road to eventually end up on 4500 South and 1300 East Streets. This extension splits again near the Hillview Elementary School. One part travels west to end up in the 700 East Street storm drain and the other split passes the school and, after turning west, crosses 900 East Street at about 4200 South Street. It then travels west along the edge of a large horse pasture, and any tailwater gets into the 700 East Street storm drain at about 4200 South Street.

Very little storm runoff gets into the Miller's extension of the Big Ditch. The only known contributing areas within the Central Drainage Area are the parking lot of the Hillview Elementary School and the Country Villa's subdivision. These areas contribute little runoff, and historically little, if any, tailwater or storm runoff enters the existing 700 East Street storm drain from this irrigation ditch.

The main line of the Big Ditch Irrigation Canal forms, for the most part, the northern boundary of the Central Drainage area. It collects a significant amount of storm runoff outside of this drainage area. The peak flow of runoff carried is estimated to be about 25 cfs which presently is carried northwesterly toward the Jordan River.

The I-9 Ditch has its beginning in the Central Drainage Area. It is fed by a high water table and springs near Murray-Holladay Road and 1700 East Street. It flows in an open channel to 4500 South Street. After crossing under 4500 South Street, it is joined by spring water from the pond just to the east. The water is then piped through the county park and softball complex where it is joined by water from an underdrain system under the softball diamonds. After crossing 1100 East Street, the water goes back into an open channel which travels through the site of the proposed Hillview Detention Basin.

The I-9 Ditch picks up storm water along its entire route. It not only collects storm runoff from the county-owned property but also from three pipe systems which drain into the I-9 ditch in the Central Drainage Area. One is a 24-inch CMP line that runs along 900 East Street north to the I-9 Ditch. Three catch basins feed this line. The second line drains a subbasin which includes a subdivision on 1250 East Street about 4500 South Street and the parking lot of a new church at 1300 East Street. The third system is located at 1500 East and 4500 South Streets.

The Lower Drainage Area is nearly completely developed and contains a large amount of high density development. The I-9 Ditch in this area is fed from numerous storm drain systems and two irrigation ditches.

The Big Ditch canal continues to flow along the north part of this area. The canal runs along a high part of the area so that most of the storm runoff flows away from the ditch. The Big Ditch then flows under State Street and out of the area. However, there is an overflow structure with a headgate at State Street. Therefore, it is possible by switching gates for water to get into the State Street Storm Drain system.

The Hill Ditch irrigation line brings water from Big Cottonwood Creek starting near Highland Drive. It flows outside the area and enters the I-9 drainage area at about 800 East Street. At 700 East Street the line splits. One line goes west along 4500 South Street and returns to Big Cottonwood Creek at about 500 East Street. The second line runs north along 700 East Street and turns west into the Old Farm property and then into the I-9 Ditch.

The line along 4500 South Street has not been used recently due to lack of interest in the irrigation water. The line along 700 East Street is used by the owners of the Old Farm Condominiums, who own most of the water rights. They use the water to supply water to two landscaped ponds.

The I-9 Ditch leaves the proposed Hillview Detention Basin area and crosses under 900 East Street, passing through the Woodlands Apartments and Commercial Office Park area now being developed by Woodlands Associates, where it will eventually be piped. It crosses 700 East Street and goes through Old Farm Condominiums and Fox Pointe Apartments. The I-9 Ditch crosses 500 East Street in a 2-1/2 by 6-foot concrete box. After crossing 500 East Street and picking up surface flows from the street, the I-9 Ditch continues west along the boundary of the Stonehedge Apartments property. The ditch enters into a 36-inch pipe at approximately 400 East Street.

A number of naturally-flowing springs on the Stonehedge property feed into the ditch. The area has a high water table, and an underdrain system drains the entire project. Midway through the Stonehedge property the I-9 Ditch branches into two parts. The smaller branch is known as the South Fork or the Gordon Ditch. The amount of water in the Gordon Ditch is controlled by diversion gates on the main line.

The Gordon Ditch leaves the Stonehedge property at its southwest corner and travels west in an open ditch through mostly undeveloped, industrial land. Near State Street it enters a 24-inch pipe. The ditch originally continued west past State Street; but when the street was widened, the flow was diverted into the State Street storm drain. This water then continues down the storm drain and enters Big Cottonwood Creek.

The main branch of the I-9 Ditch leaves the Stonehedge property at its northwest corner and soon enters a large natural pond. After leaving the pond, it travels through largely undeveloped industrial land before entering the State Street storm drain via a 60-inch pipe with minimal slope. This flow also used to pass under State Street, but is now diverted in the storm drain.

There are several existing storm drain systems in the Lower Drainage Area. The State Street system picks up storm water from the street as well as the I-9 and Gordon Ditches. A State-owned drainage line under 700 East Street closely parallels the Hill ditch irrigation line and carries water from the 4500 South Street area to the I-9 ditch. There is also a system of pipes in 4500 South Street east of 700 East Street. This system connects into the 700 East Street storm drain system. The other major existing system is a 66-inch pipe on 300 East Street which carries a 10-year storm flow of 111 cfs from the 3900 South Street area to the I-9 Ditch.

The storm drain system in the I-9 Ditch area was designed to collect and convey the 10-year storm runoff. The two proposed detention basins were sized to accommodate the 100-year event which includes 10-year storm drain inflow and the 100-year overland flow. Local interests determined that the 100-year event is approximately 1.45 times larger in total rainfall than the 10-year storm. Local interests conducted an approximate analysis of how the 100-year event flows would be routed through the I-9 Ditch Drainage Area. That analysis is presented below.

There are three locations where storm runoff waters would leave the Upper Drainage Area. The first location, and the only location where storm water would enter the Upper Detention Basin, is down 4500 South Street or directly overland from the existing canals. Most of this water would end up in the County-owned regional park property. Water on the north side of 4500 South Street would continue to the low point in the road at the I-9 Ditch crossing. It is estimated that approximately 4.6 acre-feet would flow into the Upper Detention Basin.

The second location where storm water would leave the Upper Drainage Area is at approximately Highland Drive and Lincoln Lane. This floodflow would go directly west to 1300 East Street.

The third concentrated location of excess flow would follow Highland Drive north out of the drainage area and then west on 3970 South Street. This flow amount would include the excess water that naturally drains to Holladay Boulevard.

The majority of the 100-year flows leaving the Upper Drainage Area would eventually end up in the Hillview Detention Basin. Some water would be lost to local retention or detention and approximately 4.6 acre-feet to the Upper Detention Basin.

There are three areas of significant detention that will appear in lower elevations of the Central Drainage Area.

One location is south of 4500 South Street at the I-9 Ditch crossing. This localized ponding area will contain the 100-year floodwaters generated from a local subbasin extending from 1300 East Street to Big Ditch. A second pond will be entrapped by 1300 East and 4500 South Streets north of the I-9 Ditch crossing. Approximately 3.4 acre-feet of water will converge at this location. Approximately half of that amount, or 1.7 acre-feet, will be retained in this area. The remainder will spill across 1300 East Street to the softball complex.

The third localized pond will occur within the softball diamond park complex east of 1100 East Street. At this location, water leaving the Upper Drainage Area and going west down 3970 South Street returns to the drainage area. Therefore, all the 100-year floodflows that are not retained locally reunite at 1100 East Street before entering the Hillview Basin. The existing street elevation of 1100 East Street naturally creates a storage pond of 6 acre-feet on the west portion of the park complex (east of 1100 East Street). The total overland inflow at 1100 East Street to the Hillview Basin is approximately 15.5 acre-feet. The total existing low elevation areas that flood would develop detention volumes of approximately 8.8 acre-feet. Therefore, 6.7 acre-feet of additional storage should be added to the 10-year storm drain volume requirement for Hillview Detention Basin to account for overland inflow attributable to the 100-year storm event.

The Upper Detention Basin is proposed to be located east of the future 1500 East Street and south of 4500 South Street. The Upper Detention Basin would only be used when more than 10 to 15 cfs of water is collected by the upstream storm drain system. The Upper Detention Basin detention requirements were analyzed for outlet releases of 10 cfs and 15 cfs. These requirements are summarized below.

UPPER DETENTION BASIN DESIGN REQUIREMENTS

Outlet Release (cfs)	10-Year Storm Drain Inflow (acre-feet)	100-Year Storm Overland Inflow (acre-feet)	100-Year Storm Total Inflow (acre-feet)
10	16.8	4.6	21.4
15	12.5	4.6	17.1

The Hillview Detention Basin proposed by local interests is intended to detain storm water from the I-9 Ditch drainage area. Initially, a total basin release rate of 30 cfs was anticipated. Subsequently, it was determined that releases of 15 cfs could also be utilized by the I-9 Ditch. Utilizing the 15 cfs release from the Hillview Detention Basin, the I-9 Ditch storm water storage requirements are as follows.

HILLVIEW DETENTION BASIN DESIGN REQUIREMENTS

Upper Detention Basin Release (cfs)	10-Year Storm Drain Inflow (acre-feet)	100-Year Storm Overland Inflow (acre-feet)	100-Year Storm Total Inflow (acre-feet)
10	10.0	6.7	16.7
15	18.8	6.7	25.5

The Federal plan of improvement was formulated on the basis of the following most likely without-project conditions.

a. Salt Lake County would construct a 26 acre-foot detention basin at the Hillview site.

b. Outlet release capacity of the Hillview Basin would be 15 cfs.

c. Salt Lake County would construct the Upper Detention Basin on the I-9 Ditch.

d. Outlet release capacity of the Upper Detention Basin would be 15 cfs.

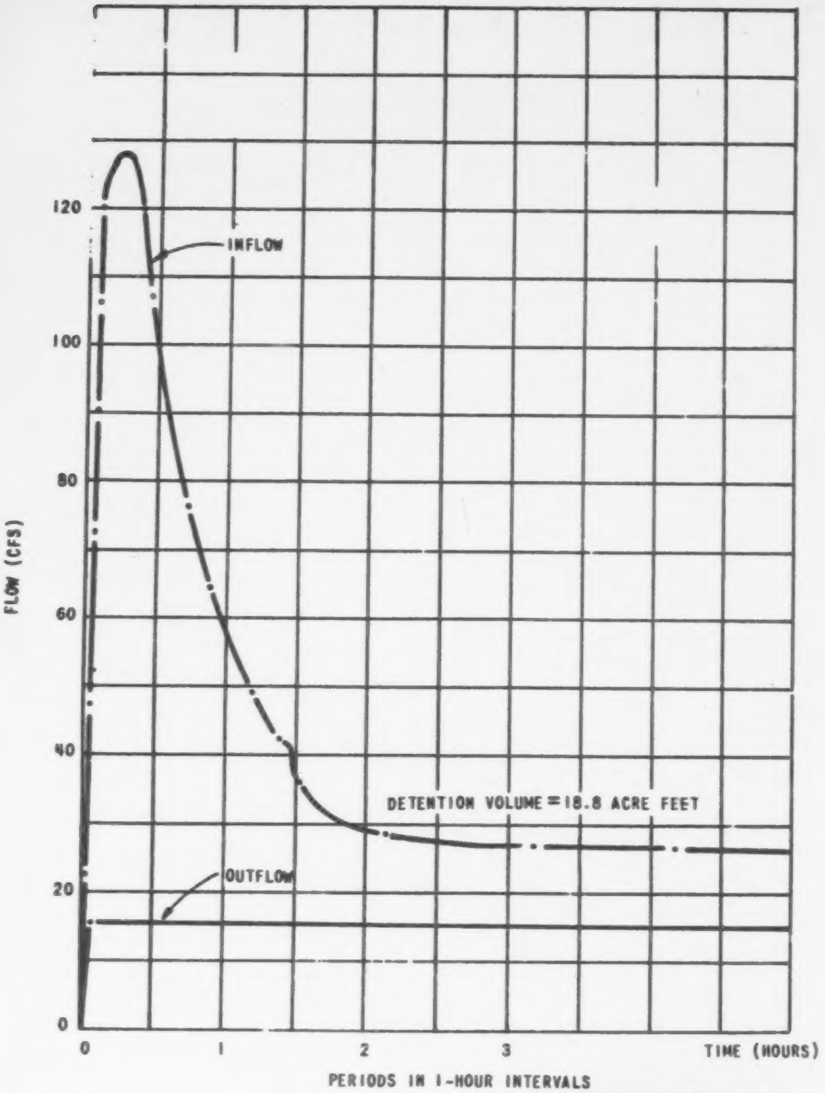
The final design of each facility is subject to change, and the impacts of any design changes or formulation of the Federal project will be reviewed during post-authorization studies. Salt Lake County's most recent statement of its intention to construct the Hillview and Upper Detention Basins was expressed in a letter which is included in Appendix A of this report. The construction of the Hillview and Upper Detention Basins is critical to the formulation of the Federal project. Consequently, the construction of these features has been included in the list of non-Federal requirements. Reformulation of the Federal project would be required if either facility is not constructed.

The system allows considerable flexibility in incorporating potential diversion from Mill Creek and in establishing a coordinated operation. The elements allowing such flexibility include preventing the 15 cfs outflow from the Upper Detention Basin from entering the I-9 Ditch drainage and increasing the outlet capacity of the Hillview Detention Basin from 15 to 30 cfs. Figures 11 and 12 show the inflow and outflow hydrographs for Hillview Detention Basin, based on 15 and 30 cfs outflows, respectively.

The local interest preliminary plan for Hillview Detention Basin is shown on Plate 13 and includes a system of levees to impound about 26 acre-feet. The operating level would be elevation 4291.6 feet for the 100-year design level. A spillway would be included for bypassing natural inflow above the 100-year level. The top of the levee is at an elevation of 4294.6 feet, providing 3 feet of freeboard above the 100-year flood level, which is the Utah State Engineer's minimum requirements for a detention basin.

RESIDUAL FLOOD PROBLEMS

The non-Federal flood control improvements alleviated many of the problems in the area for which an economical solution had earlier been established. Accordingly, flood problems and previous plans were reassessed to identify additional measures that might be taken to complement local interests' improvements. Hydrologic and economic models previously developed were updated and used to assess the hydrologic and economic effects of local improvements. The associated economic analyses were based on 1984 price levels and an 8-3/8 percent discount rate. Table 19 shows a comparison of the future hydrology and nondamaging channel carrying capacities reflecting pre- and post-local flood control improvements and plans. Flood damages and residual damages with and without local flood control plans are summarized by stream and reach in Table 20.



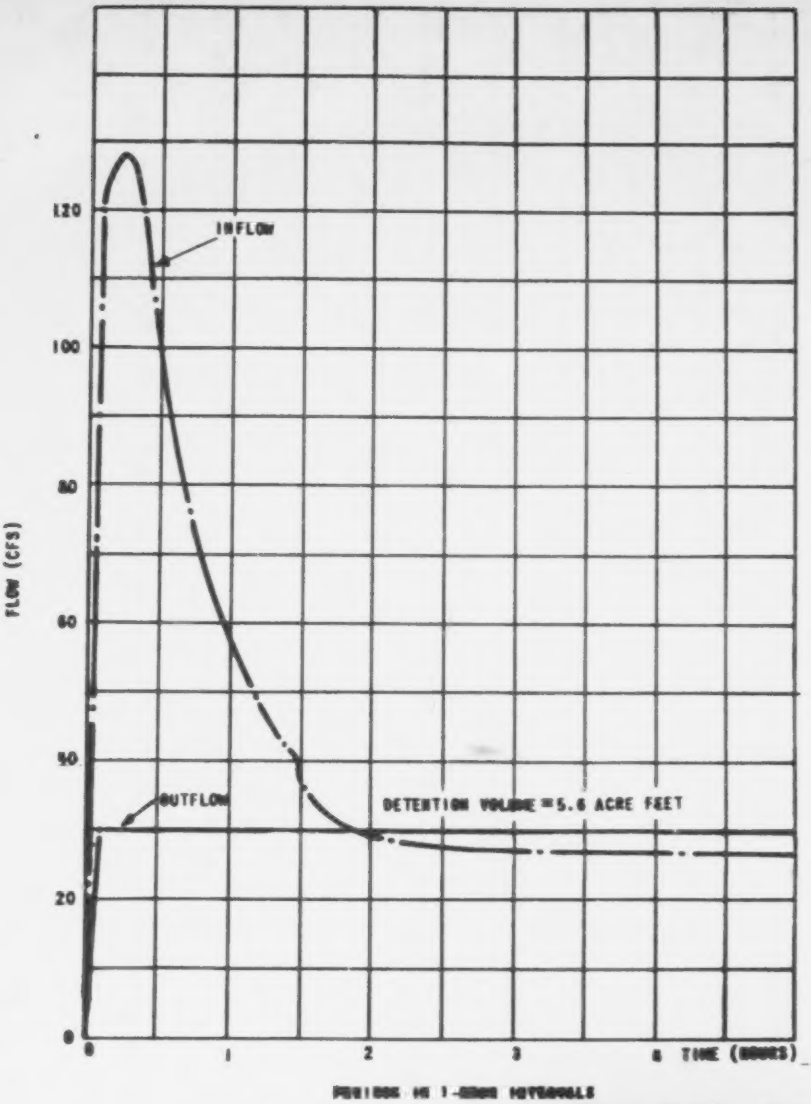
JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

HILLVIEW DETENTION BASIN HYDROGRAPH
(15 CFS FROM UPPER BASIN &
15 CFS OUTFLOW)

SACRAMENTO DISTRICT, CORPS OF ENGINEERS

DECEMBER 1986

SHEET 1 OF 1 FIGURE 11



JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION
HILLVIEW DETENTION BASIN: HYDROGRAPH
(15 CFS FROM UPPER BASIN &
30 CFS OUTFLOW)
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
OCTOBER [illegible]
SHEET 1 OF 1 FIGURE 12

TABLE 19

HYDROLOGIC DATA-FUTURE CONDITIONS WITHOUT AND WITH LOCAL FLOOD CONTROL PLANS

Stream Condition Location	Channel Capacity	Flow (cfs) Frequency 10-Yr	 50-Yr	 100-Yr	 500-Yr
MILL CREEK					
Without Local Improvements					
Above Highland Dr.	150	600	830	1,050	3,500
Highland Dr. to 700 East St.	200	810 4/	1,150	1,500	4,500
700 East St. to State St.	230	730	1,150	1,500	4,500
State St. to Jordan River	300	730	1,150	1,500	4,500
With Local Improvements					
Above Highland Dr.	600-800	600	830	1,050	3,500
Highland Dr. to 700 East St.	540	810 4/	1,150	1,500	4,500
700 East St. to State St.	630 1/	380	680	870	3,000
State St. to Jordan River	300 1/	380	680	870	3,000
BIG COTTONWOOD CREEK					
Without Local Improvements					
Above Highland Dr.	600	440	880	1,400	5,200
Highland Dr. to Creekside	600	1,240 4/	2,050	2,900	9,000
1300 East St. to State St.	400	730	940	1,100	3,200
State St. to Jordan R.	500	730	940	1,100	3,200
With Local Improvements					
Above Highland Dr.	815-1,335	440	880	1,400	5,200
Highland Dr. to Creekside	1,415	1,240 4/	2,050	2,900	9,000
1300 East St. to State St.	760-1,230	730	940	1,100	3,200
State St. to Jordan R.	500	730	940	1,100	3,200
LITTLE COTTONWOOD CREEK					
Without Local Improvements					
Above I-215 to 900 East St.	500-650	800	1,120	1,550	5,200
900 East St. to Jordan River	600-650	560	660	740	1,150
With Local Improvements					
Above I-215 to 900 East St.	1,300 2/3/	650	650	770	5,200
900 East to Jordan River	900-1200 2/	500	620	700	1,150

1/ Line values reflect Scott Avenue Detention Basin operation.

2/ Line values reflect Wheeler Farm Detention Basin operation.

3/ Reach above Wheeler Farm Basin would be the same as conditions without local improvements.

4/ Satisfies Corps criterion that the 10-year frequency discharge must exceed 800 cfs. The criterion is described in the Plan Formulation section of this report. The extent of the proposed plan of improvement will be limited to the Highland Drive to 700 East Street channel reach. The basis of claiming benefits in the remaining downstream reaches is ER 1165-2-21.

TABLE 20

AVERAGE ANNUAL FLOOD DAMAGES AND RESIDUALS 1/

STREAM	REACH	AVERAGE ANNUAL DAMAGES ($1,000) Without Local Interest Improvements Rainfloods	Without Local Interest Improvements Snowmelt	With Local Interest Improvements Rainfloods 3/
Mill Creek				
	Wasatch Blvd to Highland Dr.	248	2/	33
	Highland Dr. to 700 East St.	799	2/	603
	700 East to State St.	776	2/	178
	State St. to Jordan River	943	2/	288
	Total	2,766		1,102
Big Cottonwood Creek				
	Wasatch Blvd to 6200 South St.	12	16	7
	6200 South St. to Highland Drive	57	12	6
	Highland Drive to Creekside	363	4	125
	1300 East St. to State St.	413	25	143
	State St. to Jordan River	9	1	7
	Total	854	58	288
Little Cottonwood Creek				
	Wasatch Blvd to 6600 South St.	91	31	25
	6600 South St. to State St.	59	5	28
	900 East St. to State St.	7	13	3
	State St. to Jordan River	2	5	2
	Total	159	54	58

1/ 1984 price levels and an 8-3/8 percent discount rate.

2/ Snowmelt damages have largely been instream erosion and sediment damages which were not included in the assessment.

3/ Residual damages are primarily rainflood damages.

Improvements on Big and Little Cottonwood Creeks provide flood control to the 50- to 100-year level of protection in developed areas. Significant residual damages remain on Big Cottonwood Creek between Highland Drive and State Street. However, the damages are primarily associated with areas of limited development and damages from infrequent rainfloods. Earlier studies and local interests' evaluations indicate that providing additional flood control measures at this time to reduce the residual damages is not economically feasible. Residual flood problems and damages on Mill Creek from Highland Drive to Jordan River remain substantial and warrant continued investigation on the basis of previously identified flood control measures and continued local support. Accordingly, the investigation of a possible Federal flood control project was scaled back to include residual problems on Mill Creek only.

MILL CREEK ALTERNATIVES

Final alternatives were formulated for two separate reaches of Mill Creek to alleviate the most serious residual problem. The upper reach deals with flood problems extending from Highland Drive to State Street, and the lower reach deals with flood problems from State Street to 900 West Street.

Upper Mill Creek Reach

Within this reach, the Hillview Detention Basin alternative with associated channel improvements was reevaluated. Two alternative diversion sites and conveyance alignments were investigated. The diversion structures are similar and are designed to pass Mill Creek flows up to 200 cfs to the channel below and to divert alternative design flows of 500, 750, and 1,000 cfs to the Hillview Detention Basin. Elements of the plans are described below along with the estimated costs. Costs of Hillview Detention Basin include only those costs associated with enlarging the basin from 26 to 100 acre-feet.

Highland Drive Diversion. - The diversion structure under this alternative would be constructed across Mill Creek about 200 feet above Highland Drive. Through a system of sluice gates and an overflow weir and gate-controlled pipe entrance, the structure would provide control and passage to accommodate alternative 1,150 cfs and 1,500 cfs (50- and 100-year) flows. Plate 9 shows the details of the diversion structure. Diverted flows would be conveyed by 7,440 lineal feet of conduit connecting Mill Creek to the Hillview Detention Basin. The conduit would parallel Mill Creek to Highland Drive, then follow Murphys Lane to 1300 East Street, then follow along 1300 East Street to 4085 South Street, then follow 4085 South Street to 1100 East Street. The conduit would follow 1100 East Street to the Hillview Detention Basin site. The alignment is depicted on Plate 10. Plates 11 and 12 show the profile and conduit details. The conduit would be reinforced concrete pressure pipe and would vary in diameter from 72 inches for the 500 cfs capacity to 90 inches for the 1,000 cfs capacity. Pertinent data and preliminary estimated first costs for the Highland Drive Diversion Plan are shown below.

TABLE 21

PRELIMINARY COST ESTIMATES
HIGHLAND DRIVE DIVERSION PLAN

	Diversion Alternative		
Diversion Capacity (cfs)	500	750	1,000
Diameter Pipe (inches)	72	84	90
Diversion Structure	$ 710,000	$ 790,000	$ 860,000
Conduit	$4,170,000	$4,620,000	$5,290,000
Hillview Enlargement	$1,490,000	$1,530,000	$1,570,000
Total First Cost	$6,370,000	$6,940,000	$7,720,000

1300 East Street Diversion. - Under this alternative, the diversion structure would be located just upstream from 1300 East Street and would be similar in design to the diversion structure above Highland Drive. Alternative diversion flows of 500, 750, and 1,000 cfs were considered. Diverted flows would be conveyed by approximately 6,170 lineal feet of reinforced concrete pressure pipe. The pipe would vary from 84-inch diameter for the 500 cfs capacity to 108-inch for the 1,000 cfs capacity.

About 1,580 lineal feet of Mill Creek would require channel improvement from 1300 East Street to approximately 200 feet upstream from Highland Drive. Design and cost estimates were made for both a reinforced concrete flume and agrouted rock trapezoidal channel with side slopes of 2H to 1V. Existing structures would also require modifications. Pertinent data and costs shown on Table 22 include the cost for the concrete flume, which was less than that of a grouted rock channel.

TABLE 22

PRELIMINARY COST ESTIMATE
1300 EAST STREET DIVERSION PLAN

	Diversion Alternative		
Diversion Capacity (cfs)	500	750	1,000
Diameter Pipe (inches)	84	96	108
Diversion Structure	$ 980,000	$1,060,000	$1,130,000
Conduit	$3,820,000	$4,520,000	$5,100,000
Channel Improvement	$2,000,000	$2,000,000	$2,000,000
Hillview Enlargement	$1,490,000	$1,530,000	$1,570,000
Total First Cost	$8,290,000	$9,110,000	$9,800,000

The Highland Drive diversion plan is the less costly of the two diversion alternatives. The alternatives would have similar benefits.

ECONOMIC UPDATE

The purpose of this update is to describe flood damage data and procedures used in computing average annual inundation reduction benefits. Equivalent annual flood damages were calculated under without- and with-project conditions. This analysis was based upon a 100-year project life (1992-2092), 8-7/8 percent interest rate, and 1986 price levels.

The economic evaluation was based on standard flow-damage-frequency integration techniques under without- and with-project conditions. The without-project condition is defined as the land use most likely to occur under existing conditions, laws, and policies. An economic evaluation was conducted for the Upper Jordan River Interim Study based upon 1980 conditions. In this evaluation, flood plains were drawn and an inventory taken for structures located within these flood plains.

The severity of the September 1982 rainflood and the 1983 and 1984 snowmelt floods caused local interests to expedite efforts to mitigate the flood hazards. Local interests constructed flood control improvements which included channel modifications, bank protection, and detention basins along Mill Creek. The construction of these local flood control improvements changed the without-project condition.

In 1984, a reasssessment of the 1980 inventory updated the value, size, and type of structure in each flood plain zone. The inventory also examined future development. As a result, the inventory was now updated to the 1984 level of development, and future growth projections for structures were identified. For purposes of the economic reevaluation, the existing condition represents 1984 level of development. The year 1984 was selected as the existing condition since it represents the year of the last inventory update. The projected growth extends from 1984 to the first year of project life which is 1992.

The project hydrology was also reevaluated to include the effects of the local flood control improvements. In the economic reevaluation, the flood plains representing 1980 conditions were not redrawn because acceptable results could be obtained by assigning the updated flows and frequencies to the 1980 flood plains.

Mill Creek was divided into four reaches. The determination of these reaches was predicated upon hydrologic information. This information identified reaches based upon locations of existing gaging stations. Reach 1 corresponds to lands in the drainage area adjacent to Mill Creek from Wasatch Boulevard to Highland Drive. Reach 2 extends from Highland Drive to 700 East Street. Reach 3 extends from 700 East Street to State Street. Reach 4 was designated as the channel reach from State Street to the Jordan River.

Types of Flood Damages

The tangible damages in this analysis are physical damages caused by inundation and flood emergency losses or costs incurred in fighting or preparing for flooding. Physical damages include damages to buildings; contents, including furnishings, equipment, stock of materials in process, and inventories; damages to lot improvements including cleanup; and damages to roads, parking areas, and other improvements. Historical damages were used where possible to give credence to the analysis.

Physical losses were estimated for the following land use categories: residential, commercial, industrial, and public. Residential losses include those damages resulting to structures, contents, yard areas, and private roads. Both commercial and industrial losses include damages to structures, fixtures, and inventories. Included in public facility damages are structures, contents, and lot damages to public buildings as well as damage to roads, municipal water systems, utilities, and sewage treatment facilities.

Emergency costs are the expenses that result from a flood that would not otherwise be incurred. Examples of emergency costs are the cost of evacuation and reoccupation, flood fighting, and disaster relief; increased cost of normal operations during a flood; and increased cost of police, fire, or military protection.

Measurement and Projection of Physical Flood Losses

Three steps were used to measure flood damages for existing and future years: estimating the number and size of the physical units; estimating the existing and future values of units; and determining the damage susceptibility of these units. A flood plain inventory was conducted to identify the location, market value, and number of structures within the major land use categories of residential, commercial, industrial, and public. The market values of structures were adjusted to 1986 price levels using the consumer price index.

Residential units were differentiated among three categories: single-family dwellings, multi-family dwellings, and mobile homes. Multi-family dwellings were defined as apartments, quadplexes, and duplexes. Commercial units were comprised from a comprehensive array of businesses that included motels, hotels, service stations, restaurants, grocery stores, drugstores, auto sales, and professional offices. Industrial units were an accumulation of the types of industries in the overflow area. Public structures were comprised of roads, schools, government offices, churches, recreation clubs, parks, and sewage treatment facilities.

Field investigation revealed that the flood plain has some vacant property suitable for development. Projections of future residential, commercial, industrial, and public growth were made based upon consultation with city and county officials, real estate professionals, and business leaders in the community. Care was taken to follow the Salt Lake County District Development plans and city and county zoning and land use ordinances. The number of existing and future units in the flood plain is shown in Table 23.

TABLE 23

EXISTING AND FUTURE UNITS
IN THE MILL CREEK OVERFLOW AREA

Category	Existing (1984)	1992	2002	2012	2022	2032	2042-2092
Residential							
Single-Family	1,343	1,427	1,471	1,516	1,567	1,614	1,638
Multi-Family	997	1,333	1,507	1,690	1,887	2,065	2,147
Mobile Homes	132	122	122	122	122	122	122
Commercial	414	481	516	552	591	631	654
Industrial	16	28	33	38	43	48	51
Public	8	8	8	8	8	8	8

The value of structures in the Mill Creek flood plain was inventoried in 1980. Adjustments to the inventory were made in 1984. The values of existing properties in the flood plain were initially obtained from public officials and real estate professionals. These data were updated by actual sales values as available. The Consumer Price Index was used to index the market value of structures to 1986 prices.

In estimating the future value of physical units subject to flooding, unit values of residential, commercial, industrial, and public properties were not increased over time. Increases in the total value of commercial, industrial, and public properties in the flood plain resulted from expansion of existing facilities as well as construction of new units which were identified and evaluated as new development. With the exception of contents, the value of residential structures was not increased over time. Increases in the market value of residential structures resulted from new development.

Under existing conditions, the value of contents for residential structures was equal to 50 percent of the market value of residential structure values. The value of household contents is expected to increase as per capita income rises. The 1980 OBERS Series E growth rate for per capita income in the SMSA 7160 Salt Lake City — Ogden, Utah, EA 165 was used to project the affluence effect on the value of residential contents. The value of residential contents was projected to a maximum level of 75 percent of the value of residential structures and held constant thereafter.

The value of property by type of structure in the Mill Creek flood plain is shown in Table 24. This table is a summation of the market values of structures within the four reaches of the flood plain. The value of property for residential structures includes a value for both structures and contents. The value of property for commercial and industrial structures includes values for structures, inventory, fixtures, and equipment. A value for public properties was not presented since the value of roads, utilities, and bridges was not estimated.

TABLE 24

VALUE OF PROPERTY FOR STRUCTURES
IN THE 500-YEAR FLOOD PLAIN
(1986 PRICE LEVEL AND 1984 CONDITIONS)
($1,000's)

Category	Existing
Residential	
Single Family	190,982
Multi-Family	56,956
Mobile Homes	6,507
Commercial	346,323
Industrial	14,691
TOTAL	615,459

After an inventory of the type, number, and market values of physical structures in the flood plain, damage susceptibility relationships were established as a function of total value for each physical unit. Depth-damage relationships were used to determine the damages for different depths of flooding. Damage-flow relationships were used to establish the flood damage for selected frequencies. The derivation of these damage-flow relationships was based upon estimating the probable flood damages of several hypothetical floods. The probable flood damage that results from a particular flow was derived by describing the flood plain area affected with a given flow, inventorying this area by damage category and depth of flooding, and applying the appropriate depth-damage relationship for each damage category.

Equivalent annual damages were established from the expected value of damages for a given economic condition and point in time. They were determined by weighing the estimated damages for varying degrees of flooding by their probability of occurrence and were computed by measuring the area under the damage-frequency curve using standard mathematical integration procedures. Inundation reduction benefits were calculated by comparing the equivalent annual damages without the project to the residual annual damages that would occur with alternative flood control plans. The residual equivalent annual damages were subtracted from the without-project annual damages to compute the inundation reduction benefits for each alternative.

Tables 25 and 26 show the undiscounted without-project equivalent annual damages, respectively, for the existing condition and for projected development from 1992 through 2092. Table 27 shows the array of undiscounted equivalent annual benefits for each plan for the existing condition and for projected development from 1992 through 2092. Table 28 shows the discounted equivalent annual damages and benefits for a 100-year project life (1992-2092), an interest rate of 8-7/8 percent, and 1986 price levels.

TABLE 25

UNDISCOUNTED WITHOUT-PROJECT EQUIVALENT ANNUAL DAMAGES
($1,000)
1986 Price Level

Reach	Existing 1/	1992	2002	2012	2022	2032	2042-2092
1	35	36	37	37	37	37	37
2	628	693	752	773	796	817	828
3	182	198	212	218	225	231	234
4	278	303	318	329	341	353	359

1/ The existing condition represents development in the year 1984.

TABLE 26

UNDISCOUNTED WITH-PROJECT EQUIVALENT ANNUAL DAMAGES
($1000)
1986 Price Level

Reach	Plan	Existing 1/	1992	2002	2012	2022	2032	2042-2092
1	500 cfs	35	36	37	37	37	37	37
	750 cfs	35	36	37	37	37	37	37
	1000 cfs	35	36	37	37	37	37	37
2	500 cfs	161	185	205	215	225	235	240
	750 cfs	121	141	157	165	174	182	186
	1000 cfs	101	119	133	140	148	156	160
3	500 cfs	80	90	99	103	108	112	114
	750 cfs	69	79	86	90	95	99	101
	1000 cfs	61	70	77	81	85	89	91
4	500 cfs	119	135	144	151	159	167	172
	750 cfs	115	130	138	145	153	160	165
	1000 cfs	110	124	133	139	146	154	158

1/ The existing condition represents development in the year 1984.

TABLE 27

UNDISCOUNTED EQUIVALENT ANNUAL BENEFITS
($1000)
1986 Price Level

Reach	Plan	Existing 1/	1992	2002	2012	2022	2032	2042-2092
1	500 cfs	0	0	0	0	0	0	0
	750 cfs	0	0	0	0	0	0	0
	1000 cfs	0	0	0	0	0	0	0
2	500 cfs	467	508	547	558	571	582	588
	750 cfs	507	552	595	608	622	635	642
	1000 cfs	527	574	619	633	648	661	668
3	500 cfs	102	108	113	115	117	119	120
	750 cfs	113	119	126	128	130	132	133
	1000 cfs	121	128	135	137	140	142	143
4	500 cfs	159	168	174	178	182	186	187
	750 cfs	163	173	180	184	188	193	194
	1000 cfs	168	179	185	190	195	199	201

1/ The existing condition represents development in the year 1984.

TABLE 28

DISCOUNTED AVERAGE ANNUAL DAMAGES AND BENEFITS ($1000)
8-7/8 Percent Interest Rate 1986 Price Level

		Diversion Capacity (cfs)					
		500		750		1000	
Economic Reach	Without Project Damages	Residual Damages	Benefits	Residual Damages	Benefits	Residual Damages	Benefits
Wasatch Blvd to Highland Dr	36	36	0	36	0	36	0
Highland Dr to 700 East St	745	204	541	156	589	133	612
700 East St to State St	211	98	113	86	125	77	134
State St to Jordan River	319	145	174	139	180	133	186
TOTAL	1311	483	828	417	894	379	932

First cost, annual cost, and annual benefits are summarized in the tabulation below for the diversion capacities investigated. Annual economic costs are based on a 100-year period and an 8-7/8 percent interest rate. Annual operation and maintenance costs of $20,000 are included in annual costs. The data are also represented graphically in Figure 13.

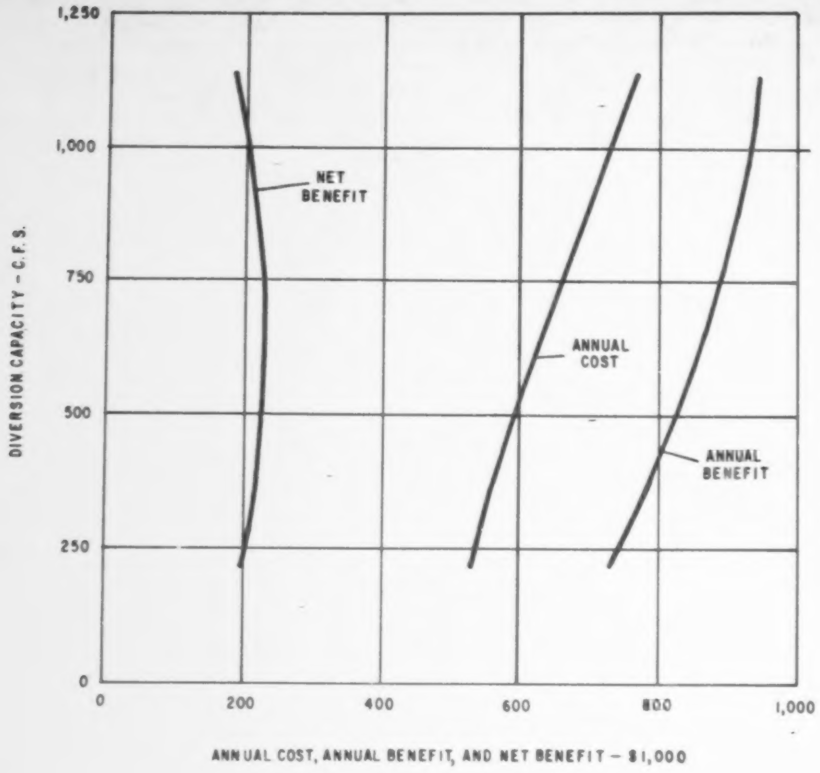
Economic Analysis
Above Highland Drive Diversion Alternative

Item	Diversion Sizes (capacity) 500 cfs	750 cfs	1,000 cfs
First Cost	$6,370,000	$6,940,000	$7,720,000
Annual Costs	$ 585,000	$ 636,000	$ 705,000
Annual Benefits	$ 828,000	$ 894,000	$ 932,000
Net Benefits	$ 243,000	$ 258,000	$ 227,000

The 750 cfs diversion alternative has the greatest net benefit and is therefore the NED plan. This plan would provide approximately 100-year flood protection and is the plan that is recommended for implementation.

Lower Mill Creek Reach

The lower Mill Creek reach extends from State Street downstream about 5,700 feet to a point 200 feet below the Denver and Rio Grande Railroad yards. The reach encompasses the gap between local interests' improvements above Main Street and those below the railroad yards. Potential improvements were investigated to accommodate a design flow of 700 cfs. The improvements considered included intermittent levees and lowering the flowline by up to 4 feet to eliminate backwater effects above critical bridges and to improve channel hydraulics by creating a uniform channel slope from 900 West Street to 300 West Street. The channel cross section below the project reach, to be improved by local interests, would have a 40-foot base width, 2 H to 1 V side slopes, and a design depth of 6.1 feet. A concrete section would be required at the lower terminus of the project reach to provide transition from an 18-foot-wide concrete vertical walled channel required through the railroad yards to retain the existing railroad bridges. Above the railroad bridges the channel would be an earth-lined, 25-foot-wide, 6-foot-deep trapezoidal channel with 2 H to 1 V side slopes. The design velocity would be about 3 feet per second. The 18-foot by 6-foot, I-15 concrete box culvert invert would be lowered 2.5 feet by constructing a 9-foot-wide trapezoidal low flow channel. Above I-15 the channel would be earth-lined except in vicinity of 300 West Street where a concrete trapezoidal channel is required to avoid extensive impacts on existing buildings. The earthen channel reaches would have base widths of about 20 feet and 2 H to 1 V side slopes. The Union Pacific railroad culvert below West Temple Street would be replaced by a reinforced concrete box culvert, eliminating backwater effects and allowing the existing channel above that point, and within the project reach, to carry the design flow. First cost of the improvements is estimated at $3,288,000, including $1,910,000 for improvements and $1,378,000 for rights-of-way.



JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM
INVESTIGATION

UPPER MILL CREEK PLAN

ANNUAL COSTS, BENEFITS, AND NET BENEFITS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SEPTEMBER 1986

FIGURE 13

impacts on existing buildings. The earthen channel reaches would have base widths of about 20 feet and 2 H to 1 V side slopes. The Union Pacific railroad culvert below West Temple Street would be replaced by a reinforced concrete box culvert, eliminating backwater effects and allowing the existing channel above that point, and within the project reach, to carry the design flow. First cost of the improvements is estimated at $3,288,000, including $1,910,000 for improvements and $1,378,000 for rights-of-way.

Average annual benefits associated with lower Mill Creek measures are about $60,000, compared with annual costs of $285,000. The resulting benefit-cost ratio is 0.2 to 1.

Economic Analysis[1/]
Lower Mill Creek
(1984 Prices, 8-3/8 Interest Rate)

Item	Economic Condition
First Cost	$ 3,288,000
Annual Cost	$ 285,000
Annual Benefits	$ 60,000
Benefit-Cost Ratio	0.2

[1/] The benefit analysis was not updated to current price level or interest rates since the original evaluation indicated a benefit-to-cost ratio of less than unity.

Although the improvements on lower Mill Creek complement local interest plans and provide an overall effective flood control plan for Mill Creek, they are infeasible and were dropped from further consideration.

THE SELECTED PLAN

The selected plan of improvement, its accomplishments, environmental effects, project operations, and design and construction considerations are described in the following paragraphs.

PLAN DESCRIPTION

The Mill Creek flood control plan, shown on Plate 8, includes a diversion structure located about 200 feet above Highland Drive, a small sediment debris trap incorporated into the diversion structure, a 7,440-foot-long, 84-inch-diameter reinforced concrete conduit connecting Mill Creek with the Hillview Detention Basin, and enlargement of the Hillview Detention Basin. The debris trap is designed to remove coarse material, greater than 2 millimeters, from the 100-year sediment load at the diversion site. The diversion structure is designed to pass flows up to 200 cfs to the downstream channel of Mill Creek as open channel flow. The diversion structure is designed to force flows exceeding 200 cfs to go through a hydraulic jump, a decrease in flow velocity and an increase in flow depth. At flows above 200 cfs, the increased flow depths serve as a driving head on a side overflow weir. As flow passes over the weir, it is collected in a side channel flume and routed to the diversion conduit for conveyance to the Hillview Detention Basin. The diversion conduit is designed to carry up to 750 cfs. The diversion conduit flows would be regulated by an automated sluice gate which would close automatically when the detention basin is filled to capacity. The diversion structure is capable of passing the entire 100-year flow to the channel through two 7-foot-wide by 5-foot-high openings, controlled by automated sluice gates. The operation of these gates would be coordinated with the conduit gate so that they would open fully as the conduit gate closes. Three auxiliary 6-foot-wide bays equipped with stoplogs would augment the passage of flows up to a maximum of 1,500 cfs. Larger flows, including the SPF and PMF, would overtop the structure with little resulting damage to the structure. A side channel flume would direct the diverted flows into the conduit. Plate 9 shows the diversion structure, debris trap, and a trash rack associated with the diversion structure for debris and sediment control. The conduit extending from the diversion structure to Hillview Detention Basin would be reinforced concrete. Plan and profile drawings are shown on Plates 10 and 11, respectively. The alignment would follow streets and would be sited so as to have a minimum of 4 feet of overburden for crossover of water lines. The conduit would outlet into an energy dissipator structure at the Hillview Basin.

The Federal plan of improvement provides for enlarging the Salt Lake County Hillview Detention Basin from 26 to 100 acre-feet. The enlargement would be accomplished by raising and extending the levees of the County basin and by excavating 15,500 cubic yards of unsuitable material from the upper portion of the basin. Also, 7,450 cubic yards of material in the County levee system will be excavated and used to build the new levees.

The detention basin will have a two-level spillway as shown on Plate 14 to pass the local runoff SPF and PMF that occur in the I-9 Ditch drainage basin. The normal operating elevation of the spillway would be at 4294.6 to pass the local SPF. This portion of the spillway would have a bottom width of 160 feet and a top width of 200 feet. The upper level of the spillway would be contiguous to the lower level and would have a sill elevation of 4296.1. The bottom width would be 200 feet and the top width would be 240 feet. The upper and lower levels of the spillway would act in concert to pass the local runoff PMF. The elevation of the local runoff PMF would be approximately 4299.5 feet at the spillway. A levee with crown elevation of 4300.0 feet would extend approximately 280 feet from the upper level of the spillway along the north side of the detention basin to a levee abutment which has a crown elevation of 4302. The levee abutment extends about 160 feet to a point where it ties into existing high ground. The spillway and north levee would be protected from erosion with roller compacted concrete (RCC). The north levee abutment would be hardened with RCC to elevation 4,302.0 feet.

To protect residences south of the detention basin from the backwater effects of the local SPF, a levee with crown elevation of 4300.0 would be constructed. The south levee would not be protected with RCC since it would not be subjected to overflow conditions that may occur at the north levee. The elevation of the local PMF at the south levee is approximately 4301.7 feet. At that elevation the PMF would outflank the south levee and pond south of it. This does not represent a worse condition than would exist without the project. Freeboard was not provided on the south levee because it would prevent the PMF from draining from the area south of the south levee and would cause increased ponding in that area.

No freeboard is provided on the north levee for the PMF except at the levee abutment, because the levee is hardened with RCC and is designed to accommodate overtopping. Minimal freeboard (2 feet) was provided for the abutment because the abutment was hardened to the crown with RCC, the inflow hydrograph for the basin is short and sharp, and weir flow conditions will permit fast outflow conditions.

The RCC hardening of the spillway and north levee eliminated the need for erosion protection on those features. Erosion protection was not provided for the south levee because floodwaters will not be in the basin for any significant period of time, and wind fetches for the basin are short. Consequently, wave heights will not be significant. Furthermore, in conjunction with operating and maintaining the project, Salt Lake County may elect to seed the interior of the detention basin with grass as has been done at the County-owned Scott Avenue detention basin. The grass would limit erosion.

Embankment material for the levees and for the RCC will be imported from sources 4 and 5 miles southeast of the basin. Material to be excavated in the upper portion of the basin will be placed in an area east of the north levee. The upper (east) portion of the detention basin will be excavated up to a depth of 5 feet to provide the required flood storage capacity. Ground water in this portion of the basin is within 2 feet of the existing surface. A subsurface drainage system will be used in this part of the detention basin to protect levee foundations. The subdrain will consist of

6-inch-diameter lateral drains spaced 50 feet on center. A 12-inch-diameter pipe will collect water from the lateral drains. An 18-inch diameter pipe will carry the water from the collection system outside the detention basin to the toe drain located along the north levee.

The County-owned outlet structure located at 900 East Street, which consists of two 12-inch pipes, will be relocated to accommodate levee and spillway modifications associated with the Federal project. The 12-inch pipes will carry water from the detention basin to a storm drain junction box located at 900 East Street.

Two 24-inch conduits would carry the water from the junction box to Big Cottonwood Creek. Local runoff SPF and PMF overflow would be accommodated by the hardened overflow sections which would direct the discharge to the natural downstream flood plain. This would basically be the same for without- and with-project conditions. Mitigation features would be limited to revegetation in the vicinity of the diversion structure and in the area of the detention basin.

PLAN ACCOMPLISHMENTS

The plan will provide nearly a 100-year level of protection from rainfloods from Highland Drive to State Street and will permit passage of snowmelt floods well above the 500-year flood. Below State Street, the project reduces flow by about 360 cfs for the 100-year flood. Annual flood damages prevented would average about $894,000, based on 1986 price level and an 8-7/8 percent interest rate. Although the project would prevent flooding from all events up to nearly a 100-year flood, benefits would accrue from floods of greater magnitude because of the reduction in flood stage.

Plan accomplishments are displayed in Table 29, the System of Accounts. The plan fully meets the objective of assisting local governmental entities in resolving flood and related problems consistent with contributing to the national economic development account. Specifically, the plan reduces flood damages consistent with ensuring a net increase in the national economic development account and providing a high degree of protection in an urban area. The plan features and measures adopted also reduce the erosion, sedimentation, and other adverse effects of floodflows. The diversion and detention storage regulate the water and permit increased incidental beneficial use of the regulated releases for irrigation, industrial, and wildlife use along the lower Jordan River and Surplus canal. The plan complements local flood control measures by increasing both the extent and the degree of protection.

TABLE 29

SYSTEM OF ACCOUNTS

ITEM	NO ACTION ALTERNATIVE	SELECTED PLAN
Plan Description	No Federal action to reduce flood damages.	Increased flood protection through diversion, conveyance, and detention storage measures.
CONTRIBUTIONS TO PLANNING OBJECTIVES		
1. Flood Control	No contribution.	Increase flood protection from 10- to 50-year up to nearly 100-year level for the reach Highland Drive to State Street.
2. Preservation of environmental values	No contribution.	Loss of vegetation and other environmental impacts associated with construction areas. Some mitigation by revegetation. Reduced environmental damages in protected areas.
3. Consistent with Local Improvements	No contribution.	Complements local plans by increasing flood protection
NATIONAL ECONOMIC DEVELOPMENT		
1. Total First Cost	None	$7,180,000
2. Annual Cost	None	$ 672,000
3. Annual Benefit	None	$ 894,000
4. Net Benefit		$ 222,000
5. B-C Ratio		1.3:1
ENVIRONMENTAL QUALITY		
1. Riparian and Wetland Vegetation	Much of riverbank is private land; native riparian vegetation has largely been replaced, and will continue to be replaced, by grasses and ornamental plants.	Diversion and conveyance measures would have little effect on riparian and wetland vegetation. Permanently displaced vegetation at the diversion site would be mitigated by revegetating streambanks. Low flow would continue along Mill Creek. Disturbed areas in the detention basin will be revegetated.

TABLE 29 (cont'd)

ITEM	NO ACTION ALTERNATIVE	SELECTED PLAN
2. Fish	Mill Creek provides a limited fishery resource in the study reach. Silting and debris would continue to limit aquatic invertebrate production. Variable streamflow would also continue to affect the fishery, particularly below diversion points where dewatering often takes place.	Diversion of floodflow would reduce silting and debris in a 5-mile reach of Mill Creek and would reduce the high flows.
3. Wildlife	Dominant wildlife includes passerine birds. Other species include small mammals, amphibians, and reptiles.	The minor reduction in riparian vegetation and other cover would cause a temporary decrease in bird and wildlife habitat.
4. Rare, Threatened, and Endangered Species	There are no known rare, threatened, or endangered species of wildlife, flora, or fauna.	No impact.
5. Water Quality	High quality flow is largely diverted for irrigation use near the canyon mouth. Flow through the urban reach consists largely of return flow and will continue to be of poor quality due to high concentrations of coliform, nitrate, phosphorus, BOD, and turbidity.	Reduction in floodflows would reduce erosion, debris, and turbidity.
6. Esthetics	The project area has not been the subject of an intensive, complete, cultural resources survey. Existing data does indicate the presence of 41 prehistoric and 129 historic period cultural resource sites in Salt Lake County. One prehistoric and one historic site are known to be located within 1/4 mile of Mill Creek.	Impacts to cultural values are unknown due to the lack of complete inventory and evaluation studies. The Hillview Detention Basin has been examined and no cultural sites were encountered. The Utah State Historic Preservation Officer (SHPO) has requested on-site monitoring during construction in the basin due to both poor ground visibility during the survey and as a

TABLE 29 (cont'd)

ITEM	NO ACTION ALTERNATIVE	SELECTED PLAN
	Available data suggest the likelihood of addiitional sites dating to both the prehistoric and historic periods.	result of the recent discoverey of a Fremont Period site in downtown Salt Lake City.
7. Cultural Resources	The project has not been the subject of an intensive, complete, cultural resources survey. Existing data indicate the presence of 41 prehistoric and 129 historic period cultural resource sites in Salt Lake County. One prehistoric and one historic site are known to be located within one-fourth mile of Mill Creek. Available data suggest the likelihood of additional sites dating to both the prehistoric and historic periods.	Impacts to cultural values are unknown due to the lack of complete inventory and evaluation studies. The Hillview Detention Basin has been examined, and no cultural sites were encountered. The Utah State Historic Preservation Officer (SHPO) has requested on-site monitoring during construction in the basin due to both poor ground visibility during the survey and as a result of the recent discovery of a Fremont Period site in downtown Salt Lake City.
REGIONAL ECONOMIC DEVELOPMENT		
1. Local Government	Local governmental resources are committed to local interest flood control measures. Flood fight activities will continue to place demand on the limited financial resources.	Emergency flood fighting costs would be reduced. Local government would be required to finance its share of the project first cost and O & M costs.
2. Land Use	Residential development would continue on vacant lots and older individual homes would continue to be replaced to a high degree by multiple-family dwellings.	Little effect except flood proofing cost for new developments would be reduced.

TABLE 29 (cont'd)

ITEM	NO ACTION ALTERNATIVE	SELECTED PLAN
4. Public Facilities	Flood damages to roads, bridges, utilities, and other public facilities would continue.	Reduced damages to public facilities.
5. Public Services	Emergency and public services would continue to be interrupted by flooding.	Reduced interruption of public services.
OTHER SOCIAL EFFECTS		
1. Displacement of People	Temporary evacuation during flooding would continue and would increase due to increased flooding.	Reduced frequency and extent of temporary evacuation.
2. Transportation	Increased flood threat to roads, bridges, and utilities.	Reduced traffic disruption and associated impacts. Temporary increase in traffic congestion during construction.
3. Employment	Labor force expected to increase. Minor impacts to labor force residing in the flood plain.	Little effect except for short-term construction employment.
4. Safety	Population in the flood plain would continue to be subject to hazard from flooding.	Reduced flood threat and safety hazards.
5. Resources and Energy	Local resources and energy demands would increase due to increased flooding.	Resources and energy would be required during construction but would result in a decrease in flood fight commitments.

EFFECTS OF THE PLAN ON THE ENVIRONMENT

The selected plan will cause some positive as well as some minor negative impacts on environmental resources of Mill Creek. The diversion and conveyance facilities would permanently displace about 0.3 acre of vegetation at the diversion site. To compensate for this loss, native riparian trees will be planted in bank areas where riparian vegetation does not exist. The conduit would be located along street alignments, and no vegetation would be lost. The enlargement of the existing basin would cause loss of existing wildlife habitat values. About 1.5 acres will be affected by construction. Upon completion of construction the basin will be allowed to revert back to its preproject condition. Some natural revegetation will take place, but to aid this process and to reduce soil erosion all disturbed areas will be revegetated with native grasses. Shrub and tree species will be planted in selected locations to maximize habitat quality. The assistance of the Fish and Wildlife Service and Utah Division of Wildlife will be sought in selecting appropriate species and in locating them to best benefit wildlife. Proposed grading plans will also be coordinated with these agencies. During construction of the diversion structure, flows would be bypassed around the diversion site to avoid dewatering the stream and affecting fish and wildlife habitat. Fish screens at the diversion pipe entrance could be included, if found to be justified, to eliminate the loss of fish from the stream. Features have not been included in the diversion structure to allow fish to pass upstream. The value of the stream as a fishery will be reviewed during post-authorization studies. A fishway will be considered at that time if warranted. Environmental impacts associated with the conduit would be limited to traffic disruption, construction dust, and noise along the alignment. Positive environmental effects are associated with reduced floodflows and reduced erosion, sedimentation, and debris in the 5-mile reach of Mill Creek below the diversion facility. Thus, water quality and habitat will be improved. Table 30 shows effects of the selected plan on nationally recognized resources. The Fish and Wildlife Service has provided a Coordination Act report, and this is included with the Final Environmental Impact Statement.

An intensive cultural resources survey of the Hillview Detention Basin suggests that no cultural sites would be impacted by this project feature. Due to survey conditions, however, the Utah State Historic Preservation Officer (SHPO) requests on-site monitoring during the course of construction activity. No other project features have been inventoried for cultural values. Such studies will be completed in the advanced planning stages of the project, and the requirements of both the National Historic Preservation Act of 1966, as amended (16 USC 470), and Title 36 Part 800 of the Code of Federal Regulations will be satisfied prior to project initiation. Impacts to any sites determined eligible for, or listed on the National Register of Historic Places, will be avoided if possible. If impacts cannot be avoided, appropriate protective/mitigative measures, developed in accordance with the above noted laws and regulations, will be implemented.

The selected plan would not have any significant adverse effects on the I-9 Ditch or Big Cottonwood Creek because water held in the Hillview Detention Basin can be released under controlled conditions.

TABLE 30

EFFECTS OF THE SELECTED PLAN ON RESOURCES OF NATIONAL RECOGNITION

Types of Resources	Authorities	Measurement of Effects
Archeological and Historical	National Historic Preservation Act of 1966, as amended (16 USC 470) and the Historical and Archeological Data Preservation Act of 1974, as amended (16 USC 469).	Unknown at this time; any adverse impacts will be avoided or mitigated
Air Quality	Clean Air Act, as amended, 42 U.S.C. 7401, et seq.	No effect
Endangered and Threatened Species	Endangered Species Act, as amended, 16 U.S.C. 1451, et. seq.	No effect
Fish and Wildlife habitat	Fish and Wildlife Coordination Act, as amended, U.S.C. 661, et. seq.	Fish habitat: short-term degradation during construction. Long-term improvement due to stream stabilization and reduced erosion, sediment, and debris. Wildlife habitat: temporary minor loss with revegetation.
Flood plains	Executive Order 11988 Floodplain Management	Work will occur in the floodplain and result in reduced flood damages.
Water Quality	Clean Water Act of 1977, as amended, 33 U.S.C. 1251, et. seq.	Short-term degradation during construction of diversion structure. Long-term water quality improvement due to reduction of floodflows, erosion, sedimentation, and debris.

PROJECT OPERATIONS

The project operation was developed using the HEC-1N model and sizing the diversion and conveyance facilities to accommodate design flows near the 100-year magnitudes. Flows were analyzed for 5-minute intervals at selected index stations to reflect future hydrology for without local interest improvement conditions, with local interest improvement conditions, and the selected plan. Table 31 shows the peak flow for the selected frequencies and for the various development conditions.

TABLE 31

PROJECT OPERATIONS - HYDROLOGIC DATA

	Peak Flow Data (cfs) 1/		
Frequency Condition	Highland Drive (Index 1202)	700 East St. (Index 1303)	Above State St. (Index 1502)
50-Year			
Without local Interest Improvements	1,120	1,000	1,100
With local Interest Improvements	1,120	660 1/	840 1/
Selected Plan	460 2/	200 2/	560 2/
100-Year			
Without local Interest Improvements	1,370	1,400	1,510
With local Interest Improvements	1,370	970 1/	1,080 1/
Selected Plan	620 2/	200 2/	720 2/

1/ Reflects operation of Scott Avenue and 550 East Detention Basins.
2/ Reflects diversions to Hillview Detention Basin in combination with operation of Scott Avenue and 550 East Detention Basins.

The flood control reservation at Hillview basin for Mill Creek diversion has been established at 74 acre-feet to provide storage consistent with the 750 cfs diversion of the 100-year flood. Channel improvements between Highland Drive and 700 East Street completed by Salt Lake County provide a conveyance capacity of 540 cfs or about midway between the 50- and 100-year flow. Local improvements between 700 East Street and State Street have a design capacity of 630 cfs.

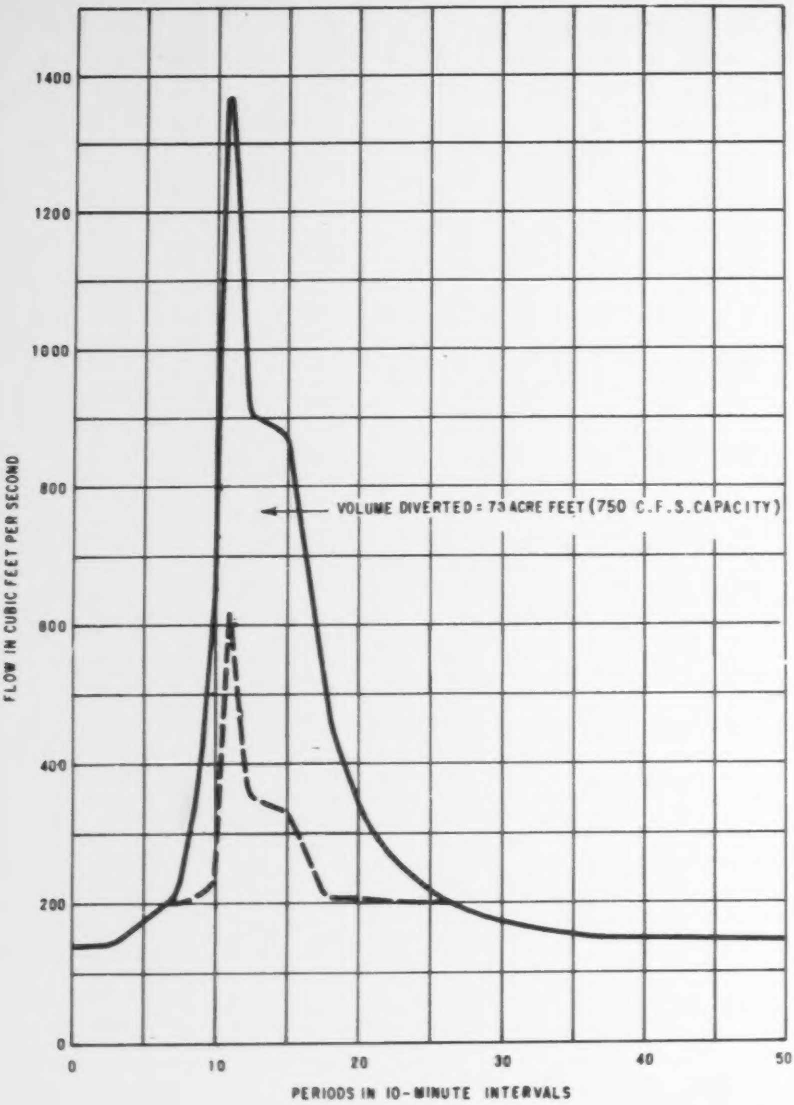
Gages would be required above the diversion structure, below the diversion structure, and at Hillview Detention Basin to provide operating data. Diversion would be made of flows exceeding 200 cfs and up to the diversion conduit capacity of 750 cfs. Operation of the diversion is not required for snowmelt runoff except as it may be deemed beneficial to attenuate daily fluctuations. Storage of 74 acre-feet at Hillview Detention Basin would be reserved for Mill Creek diversions. In the event that the capacity is reached, the gate at the pipeline entrance would be closed automatically. Telemetry would be used from the Hillview Detention Basin to the Mill Creek Diversion Structure to regulate diversions.

Diversion to Hillview Detention Basin would be coordinated with the operation of the Scott Avenue and the 550 East Street Detention Basins to optimize flood control. Figure 14 shows the flood hydrographs for a 100-year flood at three locations (near Highland Drive, 700 East, and State Street). Salt Lake County Flood Control Department will operate the Hillview Detention Basin as detention storage on a local storm drain system. About 26 acre-feet of storage regulates local storm drain flows in addition to the 74 acre-foot reservation for the Mill Creek diversion. Releases from the basin will be made through a gated outlet works to a storm drain discharging to Big Cottonwood Creek above State Street. The storm drain capacity below Hillview Detention Basin is planned at about 30 cfs, thus requiring about a day and a half to release the full capacity of the basin. The Mill Creek system below the diversion structure would require surveillance primarily during rainflood events to insure passage of floatable debris, to inform upstream operators of problems, and to inform adjacent residents if and when the basin is near capacity and bypasses and flooding may be expected. Hillview Detention Basin will include a spillway which in combination with storage will accommodate the SPF from local runoff. The PMF from local runoff will be passed through the spillway and across an overflow section. The spillway and overflow provisions are associated with local drainage contributions and would not be affected by diverted flows from Mill Creek. A spillway channel or flood easement below Hillview Detention Basin was not included because diversions will be curtailed when the basin reaches capacity.

Non-Federal interests will be required to operate the project in accordance with the plan described above. Detailed operations procedures will be described in a project operations manual. The operations manual will be developed before non-Federal interests assume their project operation and maintenance responsibilities. The Salt Lake County Department of Public Works has an experienced and sufficient staff to observe conditions during flood events and to operate the project in conformance with Federal regulations.

RISK AND UNCERTAINTY

Flood control operation and accomplishments include a small degree of uncertainty regarding the level of protection provided. This results from the uncertainty inherent in the simulated hydrologic analysis. However, the uncertainty is believed to be small since the calibration of the hydrologic model is based on historic precipitation and runoff. The project is essentially a diversion plan designed to divert floodflows in excess of channel capacities. The project will reduce overbank flooding to near the 100-year magnitude. Peak flow from levels greater than the 100-year flood would be reduced to the extent that the peak flow occurs prior to the Hillview Detention Basin reaching capacity. As Hillview Detention Basin nears capacity, the diversions would be reduced gradually. When the basin reaches capacity, diversions would be terminated and all flow at the diversion site would be released through the diversion structure. Under this circumstance, downstream flooding would be the same as without the project diversion. Flood effects would be reduced by gradually increasing releases and providing advance warning to downstream residents. Hillview Detention Basin would include a spillway and a RCC overflow section to bypass up to the PMF flow from the natural tributary area. Diverted flow from Mill Creek would be contained within the 74 acre-foot detention basin. Diversions would be curtailed once capacity is reached. The risks resulting from an uncertainty on the hydrologic analysis and associated design are small.



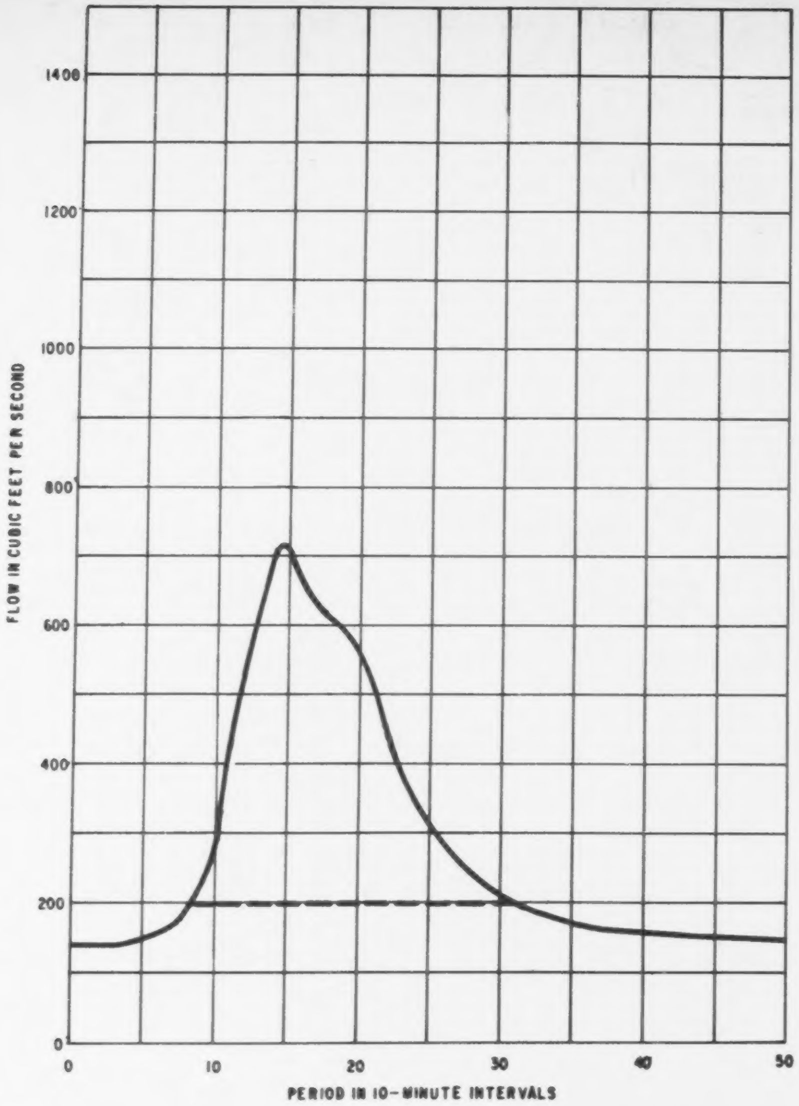
JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

MILL CREEK NEAR HIGHLAND DRIVE

100-YEAR FLOOD HYDROGRAPHS
(INDEX STATION 1203)

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MAY 1985

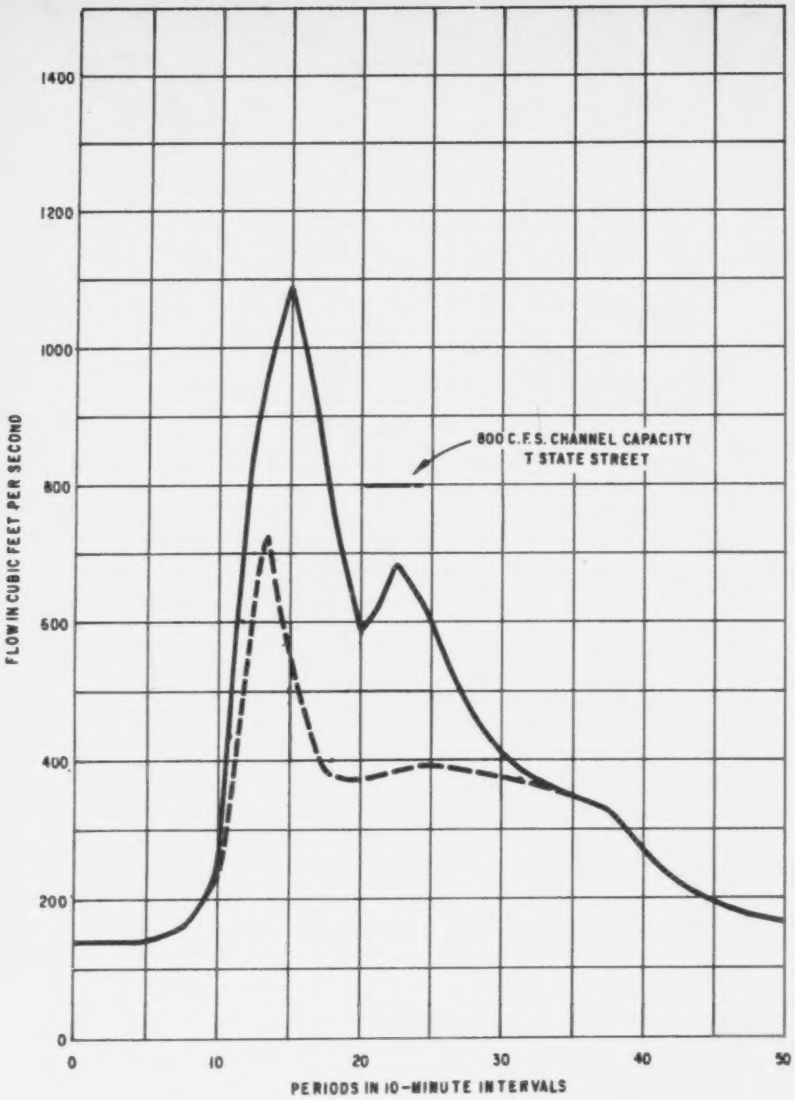
SHEET 1 OF 3 FIGURE 14



JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

MILL CREEK AT 700 EAST STREET

100-YEAR FLOOD HYDROGRAPHS
(INDEX STATION 1305)
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MAY 1985
SHEET 2 OF 3 FIGURE 14



JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION

MILL CREEK ABOVE STATE STREET

100-YEAR FLOOD HYDROGRAPHS
(INDEX STATION 1502)
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MAY 1965
SHEET 3 OF 3 FIGURE 14

DESIGN AND CONSTRUCTION CONSIDERATIONS

The diversion structure was sited in the upper reach of Mill Creek to minimize downstream channel improvements. The location approximately 200 feet upstream of Highland Drive was selected because the stream is incised and nearby houses are well above the streambanks. Flows at the site are confined to the immediate channel area, which minimizes the height and length of the diversion structure to control the design flow of 1,500 cfs. Site inspection also indicates soils at the site are more suitable than at downstream locations. The structure was designed to permit passage of low flows and bedload material smaller than 2 millimeters. A debris trap associated with the diversion structure causes a decrease in water velocity and deposition of the heavier bedload material at a site accessible for debris and sediment removal. Prior to construction, a detailed sediment study would be conducted and appropriate modification in design would be made. A modest soils and foundation exploration program would also be required for detailed foundation design and construction purposes.

Design of the diversion structure is based on hydraulics reflecting a Manning's "n" value of 0.015. The structure will convey flows up to 200 cfs through the 16-foot-wide low flow channel. The structure is designed such that flow above 200 cfs will cause a hydraulic jump in the structure, lowering the velocity and raising the water surface elevation, thus forcing overflow into the diversion intake. The sluice gate at the conduit entrance can be adjusted to regulate the diversion of flow up to the design capacity.

The diversion structure is capable of passing the entire 100-year flow to the channel through the 7-foot-wide by 5-foot-high openings controlled by automated sluice gates. The operation of these gates would be coordinated with the conduit gate so that they would open fully as the conduit gate closes. Three auxiliary 6-foot-wide bays equipped with stoplogs would augment the passage of flows up to a maximum of 1,500 cfs. The sloplogs would be in place during normal operations. The sloplogs would be removed to pass peak floodflows when the diversion pipeline is inadequate or closed. Peak floodflows normally are associated with summer cloudburst or general rainfall. These events generally occur from April to October. Since freezing temperatures and icing conditions are not likely to occur during this period, difficulty in removing the stoplogs due to such weather conditions is not anticipated. County maintenance crews would probably use a small portable crane to remove the stoplogs. Should the stoplogs become wedged or jammed in place due to ice or other conditions, the stoplogs could be easily destroyed with small power tools to allow water to pass during an emergency.

The diversion conduit was designed assuming pressure flow conditions for the design flow and a Manning's equation "n" factor of 0.015. Reinforced concrete pressure pipe was selected from the pipeline materials available in the Salt Lake City area because of the economical costs at the large (84-inch-diameter) conduit and its ability to withstand the required design heads. Other materials that were able to withstand the design pressures were found to be less economical. The diversion conduit cost estimate shown in Table 31 was based on low pressure RCP (ASTM C-361) which can withstand pressures to 125 psi. Design details of the conduit and plan and profile are shown in Plates 10, 11, and 12. Manholes will be spaced at 500-foot intervals along the conduit.

A feasibility level sediment investigation of Mill Creek was made based on available data and discussions with personnel familiar with the area. Sediment production rates used in the design analysis included an average annual sediment rate of 50,000 tons and a design event production load of 150,000 tons, with gravels and larger material (greater than 2 millimeters) comprising about 800 tons. Particles smaller than 2 millimeters will flow past the structure or through the conduit with no expected impairment to discharge capacity, although some maintenance (clearing) may be required. It is estimated that 200 tons of sediment would have to be removed annually to maintain the function of the diversion structure.

The gravel and larger sizes up to small boulders (approximately 512 millimeters) were of particular concern as these could clog the diversion structure and conduit and impair the discharge efficiency. The upstream debris trap was designed to store the coarse material for removal above the diversion site. A trash rack was included above the diversion structure to trap floatable debris.

The diversion conduit would have a drop in elevation of 99 feet over its course and a design velocity of up to 17 feet per second. Standard 36-inch manholes would be located every 500 feet for maintenance and access. The conduit would outlet into the Hillview Detention Basin at an invert elevation of 4,291.6 feet into an energy dissipator structure.

Plate 13 shows the local interests concept for the detention basin. A subdrain system was not included in the local interests plan because their plan did not require any site excavation. Plate 14 shows modifications to the local interests concept to increase storage.

The gabion baskets in the local spillway will be removed and a new spillway of RCC will be constructed as indicated on Plate 15. The crest and downstream slope of the north levee, the drainage ditch, and the intervening area between the ditch and the north levee will be protected with RCC.

The energy dissipator stilling basin at the conduit discharge point would be the Bureau of Reclamation Type VI Stilling Basin (Impact Type)(HDC 722-2). A minimum 36-inch layer of 165 pounds per cubic foot riprap or derrick stone would be provided at the stilling basin exit for a minimum of 25 feet for both the bottom and side slopes to control erosion. This material would transition to 18-inch riprap/stone. Plate 15 shows details of this structure.

Hillview Detention Basin enlargement was designed based on a limiting elevation of about 4,300 feet. This eliminates local runoff SPF backwater effects on nearby residences which are sited just above that elevation. Storage computations of the Hillview Basin indicated that, by excavating the upper portion to an elevation of 4,290 and incorporating the privately owned low-lying areas on the perimeter of the basin, the required 100 acre-feet of storage would be provided at the approximate elevation of 4,294.6. Therefore, the spillway crest was set at 4,294.6 feet, an elevation of 4,296.1 was set for the PMF overflow area, and 4,300 for the remaining portions of the levees. The north levee will be protected along its entire length by roller compacted concrete (RCC), and the abutments will be raised to an elevation of 4,302. The RCC would protect the levee from backwater effects of the local runoff PMF and from the effects of possible variations in the PMF which could cause the north levee to be overtopped. RCC was not used to protect the south levee because it would not be subject to as severe conditions as the north levee.

Soil material available in the basin is unsuitable for the construction of the levees and for RCC. Two sources of material have been located 4 and 5 miles southeast of the basin. Construction of the levees will incorporate the local levees wherever possible. This will be done by raising the existing levees. Where local levees are not used, they will be degraded and the material realized will be used for new construction. The material excavated in the upper basin will be spoiled in the north end of the drainage basin east of the north levee.

The gabion baskets in the local spillway will be removed and a new spillway of RCC will be constructed as indicated on Plate 14. The RCC will be placed in 6-inch layers. The crest and downstream slope of the north levee will be faced with RCC. In addition, the drainage ditch and the intervening area between the ditch and the north levee will be protected with RCC as indicated on Plate 14.

The soils investigation of the basin noted that the ground water level is close to the surface. To mitigate for this condition in the excavated area, a subdrain system will be installed. It will consist of 6-inch diameter lateral drains 50 feet on center. A 12-inch-diameter pipe will collect water from the lateral drains. An 18-inch-diameter pipe will carry the water from the collection system outside the detention basin to the toe drain located along the north levee. A subdrain system was not required for the locally developed basin because the volume required for the local interest plan does not require excavation. Sediment deposition will have no impact on the functioning of the subdrain system. A 1-foot-thick impervious blanket and a filter fabric will be used to prevent infiltration of material that would impair the functioning of the drain. Details of the subdrain system are shown in Plate 15.

During construction of the new spillway, the 900 East Street outlet structure constructed by local interests will be removed. Although the cost estimate for the Federal plan of improvement provides for a new outlet structure, the locally constructed outlet structure will be used if it can be removed intact. Releases through the outlet structure will flow to an existing storm drain junction box located at 900 East Street. Releases will be controlled by two sluice gates shown on Plate 15.

ECONOMICS OF THE SELECTED PLAN

First Cost

The total construction cost of the selected plan is estimated at $7,180,000 and is summarized in Table 32.

TABLE 32

COST ESTIMATE SUMMARY
THE SELECTED PLAN

FEATURE	COST ($) Federal	Non-Federal	Total
Mill Creek Diversion			
Lands and Damages	-	90,000	90,000
Mill Creek Diversion Structure	800,000	-	800,000
Subtotal			890,000
Diversion Conduit			
Relocations	-	1,670,000	1,670,000
Conduit	3,060,000	-	3,060,000
Subtotal			4,730,000
Hillview Detention Basin Enlargement			
Lands and Damages	-	400,000	400,000
Detention Basin Enlargement	1,160,000	-	1,160,000
Subtotal			1,560,000
Subtotal	5,020,000	2,160,000	7,180,000
Non-Federal Cash Contribution	(360,000)	360,000	-
Total First Cost	4,660,000	2,520,000	7,180,000

Detailed construction estimates for the major features are presented below. The rights-of-way cost estimate of $90,000 is limited to lands required in fee for the diversion structure and initial conduit reach. The diversion structure and related costs total $800,000 and are detailed in Table 33. The selected conduit plan costs are estimated at $4,730,000 and are detailed in Table 34. Enlargement of the Hillview Detention Basin will cost $1,560,000, as shown in Table 35. This includes lands costs of $400,000.

TABLE 33

MILL CREEK DIVERSION STRUCTURE
DETAILED CONSTRUCTION COST ESIMATE

ACCOUNT	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
		NON-FEDERAL			
01.	LANDS AND DAMAGES	1	Job	LS	90,000
	TOTAL NON-FEDERAL COST				90,000
	NON-FEDERAL CASH CONTRIBUTION				45,000
	TOTAL NON-FEDERAL FIRST COST				135,000
		FEDERAL			
09.	CHANNELS				
	Riprap	30	CY	45.00	1,350
	Contingency (25 percent)				650
	Subtotal				2,000
15.	DIVERSION STRUCTURE				
	Reinforced Concrete	650	CY	400.00	260,000
	Trash Rack	38.5	LF	200.00	7,700
	Excavation	850	CY	7.50	6,375
	Backfill	400	CY	10.00	4,000
	96"x96" Sluice Gate	1	EA	35,000.00	35,000
	Stop Logs	1	JOB	LS	6,000
	84"x60" Sluice Gates	2	EA	16,000.00	32,000
	6-foot Chain Link Fence	300	LF	20.00	6,000
	Walkway	1	JOB	LS	1,100
	Control of Water	1	JOB	LS	10,000
	Excavation	780	CY	3.50	2,730
	12-inch-diameter RCP	100	LF	18.00	1,800
	Reinforced Concrete	200	CY	350.00	70,000
	Excavation/Backfill Trench	75	CY	15.00	1,125
	Trashback	60	LF	350.00	21,000
	Cleanout Box	1	JOB	LS	2,000
	Automated Controls for	1	JOB	LS	70,000
	Mitigation Planting	0.4	ACRE	9400.00	3,760
	Sluice Gates				
	Subtotal				540,590
	Contingency (25 percent)				135,410
	Subtotal				676,000
30.	ENGINEERING AND DESIGN				85,000
31.	SUPERVISION AND ADMINISTRATION				39,000
	TOTAL FEDERAL COST				800,000
	NON-FEDERAL CASH CONTRIBUTION				(45,000)
	TOTAL FEDERAL FIRST COST				755,000
	TOTAL DIVERSION STRUCTURE FIRST COST				890,000

TABLE 34

MILL CREEK TO HILLVIEW BASIN CONDUIT
DETAILED CONSTRUCTION COST ESIMATE

ACCOUNT	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
		NON-FEDERAL			
02	RELOCATIONS				
02.1	Road Relocation				
	Pavement Removal	23,000	SY	1.50	34,500
	New Pavement	204,600	SF	1.90	388,740
	Traffic Control	7,440	LF	4.00	29,760
	Subtotal				453,000
	Contingency (25 percent)				112,000
	Total Road Relocation				565,000
02.7	Utility Relocation				
	Water				
	1-inch steel pipe	4,250	LF	4.00	17,000
	4-inch CIP	2,930	LF	12.00	36,625
	6-inch CIP	1,380	LF	15.00	20,700
	6-inch ACP	2,030	LF	20.00	40,600
	8-inch ACP	300	LF	25.00	7,500
	12-inch CIP	1,030	LF	26.50	27,295
	12-inch ACP	530	LF	40.00	21,200
	20-inch Conc./Stl.	70	LF	65.00	4,550
	Misc Fittings	1	JOB	LS	17,500
	Temporary Facilities	1	JOB	LS	57,000
	Subtotal				249,970
	Contingency (25 percent)				65,030
	Subtotal (Water)				315,000
	Sewer, New & Relocated				
	8-inch VCP	7,250	LF	13.00	94,250
	18-inch VCP	70	LF	42.50	2,975
	Manholes	31	LF	1,100.00	34,100
	Impacted House Connections	1	JOB	LS	10,000
	Misc Fittings	1	JOB	LS	14,100
	Temporary Facilities	1	JOB	LS	60,000
	Subtotal				215,425
	Contingency (25 percent)				54,575
	Subtotal (Sewer)				270,000

TABLE 34 (cont'd)

ACCOUNT	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
	NON-FEDERAL				
	Gas				
	1-inch Steel Pipe	4,280	LF	4.00	17,120
	2-inch STL	3,020	LF	5.50	16,610
	3-inch STL	2,170	LF	8.50	18,445
	3-1/2-inch STL	3,140	LF	18.50	58,090
	4-inch STL	120	LF	20.50	2,460
	Fittings	1	JOB	LS	11,300
	Temporary Facilities	1	JOB	LS	60,000
	Subtotal				184,025
	Contingency (25 percent)				45,975
	Subtotal (Gas)				230,000
	Miscellaneous				
	Telephone Crossings	4	EA	2,000.00	8,000
	Storm Drain Crossings	2	EA	9,000.00	18,000
	Subtotal				26,000
	Contingency (25 percent)				7,000
	Subtotal (Miscellaneous)				33,000
	Total Utilities Relocation				848,000
	TOTAL RELOCATIONS				1,413,000
30.	ENGINEERING AND DESIGN				170,000
31.	SUPERVISION AND ADMINISTRATION				87,000
	TOTAL NON-FEDERAL COST				1,670,000
	NON-FEDERAL CASH CONTRIBUTION				235,000
	TOTAL NON-FEDERAL FIRST COST				1,905,000
	FEDERAL				
09.	PIPELINE				
	84-inch RCP (ASTM-C-361)	7,440	LF	209.00	1,554,960
	Installation (Pipe Only)	7,440	LF	21.85	156,240
	Manholes	15	EA	2,000.00	30,000
	Excavation	41,400	CY	1.30	53,820
	Bedding-Gravel	4,900	CY	19.00	93,100
	Backfill-Compacted	24,300	CY	2.00	48,600

TABLE 34 (cont'd)

ACCOUNT	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
		FEDERAL			
	Trench Support	7,440	LF	8.40	62,496
	Water Control				
	3-inch Sump Pump	1	JOB	LS	50,000
	Outlet Structure	1	JOB	LS	11,000
	Subtotal				2,060,216
	Contingency (25 percent)				514,784
	Total Pipeline				2,575,000
30.	ENGINEERING AND DESIGN				330,000
31.	SUPERVISION AND ADMINISTRATION				155,000
	TOTAL FEDERAL COST				3,060,000
	NON-FEDERAL CASH CONTRIBUTION				(235,000)
	TOTAL FEDERAL FIRST COST				2,825,000
	TOTAL CONDUIT FIRST COST				4,730,000

TABLE 35

HILLVIEW DETENTION BASIN ENLARGEMENT
DETAILED CONSTRUCTION COST ESTIMATE

ACCOUNT	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
01.	LANDS AND DAMAGES				
	Fee lands-private	0.5	AC	75,000.00	37,500
	Contingency (35 percent)				12,500
	Acquisition Cost	3	EA	6,000.00	18,000
	Subtotal				68,000
	Easement Land-private	3.25	AC	60,000.00	195,000
	Contingency (35 percent)				71,000
	Acquisition Costs	11	EA	6,000.00	66,000
	Subtotal				332,000
	TOTAL NON-FEDERAL COST				400,000
	NON-FEDERAL CASH CONTRIBUTION				80,000
	TOTAL NON-FEDERAL FIRST COST				480,000
	FEDERAL				
15.	DETENTION BASIN				
	Excavation/Compaction	7,450	CY	3.00	22,350
	Import Embankment	8,050	CY	8.00	64,400
	Roller Compacted Concrete	7,350	CY	55.00	404,250
	Subdrain System				
	Excavation	1,900	CY	1.50	2,850
	6-inch diameter Perf Pipe	5,750	LF	11.00	63,250
	12-inch diameter Perf Pipe	650	LF	21.00	13,650
	Filter Fabric	2,200	SY	1.25	2,750
	Gravel Filter	1,600	TON	12.00	19,200
	Impervious Soil Layer	480	CY	4.00	1,920
	Compacted Backfill	480	CY	8.00	3,840
	18-inch diameter Concrete Pipe	520	LF	38.00	19,760
	4-ft diameter Std MH w/Ring and Bolted Cover	2	EA	2,000.00	4,000
	Stilling Basin (1100 East Street)				
	Construct Structure	1	JOB	LS	75,000
	6-inch diameter Pipe	150	LF	12.00	1,800
	Bedding	25	CY	25.00	625
	Riprap	1,400	TON	16.00	22,400
	Evacuation	500	CY	2.00	1,000
	Remove & Waste Basket Riprap	350	CY	10.00	3,500
	Outlet (900 East Street)				
	Remove & Waste Old Outlet	1	JOB	LS	1,500
	Install New Outlet	1	JOB	LS	3,500
	12-inch-diameter RCP	200	LF	18.00	3,600
	Excavate & Place Spoil Material	15,500	CY	1.80	27,900
	Mitigation Planting	1.5	ACRE	9400.00	14,000
	Subtotal				777,145
	Contingency (25 percent)				193,855
	Total Detention Basin				971,000
30.	ENGINEERING AND DESIGN				126,000
31.	SUPERVISION AND ADMINISTRATION				63,000
	TOTAL FEDERAL COST				1,160,000
	NON-FEDERAL CASH CONTRIBUTION				(80,000)
	TOTAL FEDERAL FIRST COST				1,080,000
	TOTAL DETENTION BASIN				1,560,000

Rights-of-way include project lands, associated improvements, and severance or related damages required for construction. Rights-of-way will be required, in fee, for the diversion structure and the initial section of the pipeline. A construction and access easement would be adequate for the pipeline reach located along streets, which are presently public rights-of-way. Rights-of-way for diversion facilities include an area approximately 80 feet wide and 100 feet long, at a cost of $90,000. Rights-of-way costs for the Hillview Detention Basin enlargement total $400,000, including about $68,000 for fee title lands and $332,000 for easements. About 26 acres of land, valued at about $4,040,000, is currently in Salt Lake County ownership and is associated with the local interest basin. This cost was not included in the enlargement cost.

Facilities to be relocated for project improvements include roadways and a variety of utility crossings. These are summarized in the detailed cost estimates. Relocations would cost an estimated $1,670,000 and are all associated with the conduit.

Annual Costs

Annual costs are estimated at $672,000 based on a 100-year economic analysis and an 8-7/8 percent interest rate (1992-2092 project conditions). Interest during construction was based on a six-month construction season. Operation and maintenance costs have been developed consistent with provisions that local flood protection measures shall be maintained in such a manner and at such times and over a sufficient period to ensure continued operation of the project over the project life and to insure that the project accomplishments and benefits are realized. Operation, maintenance, and replacement costs represent the average annual cost to maintain the project in accordance with the above described provisions. Annual operation, maintenance, and replacement cost would average $20,000 for the plan, based on expenditure experiences for similar projects. The allowance includes $15,000 for operation, maintenance, and replacement associated with the diversion structure and the conduit and $5,000 for sediment removal and control costs. A breakdown of the annual cost is shown in Table 36, Economic Summary.

Annual Benefits

Average annual flood control benefits were developed from the difference in flood damages without and with the project in operation. Average annual preproject damages were estimated at $1,311,000 and project flood damages at $417,000. Annual benefits would be $894,000.

Economic Summary

An economic summary of the plan is shown below. Interest during construction was considered because benefits would not accrue until the entire project is completed.

TABLE 36

ECONOMIC SUMMARY
SELECTED PLAN
(1986 Prices; 8-7/8 percent Interest Rate; 1992-2092 Project Conditions)

INVESTMENT COST	
FEDERAL	
First Cost	$ 4,660,000
Interest During Construction	103,000
Gross (or net) Investment	4,763,000
NON-FEDERAL	
First Cost	$ 2,520,000
Interest During Construction	56,000
Gross (or net) Investment	2,576,000
TOTAL GROSS (OR NET) INVESTMENT	$ 7,339,000

ANNUAL COST	
FEDERAL	
Interest	$ 422,900
Amortization	100
Total Federal Annual Cost	423,000
NON-FEDERAL	
Interest	$ 228,900
Amortization	100
Maintenance and Operation	20,000
Total Non-Federal Annual Cost	249,000
TOTAL PROJECT ANNUAL COST	$ 672,000

PLAN IMPLEMENTATION

Summarized below are the cost-sharing requirements and procedures necessary to implement the features of the selected plan.

INSTITUTIONAL REQUIREMENTS

Cost-sharing requirements for this plan of improvement are included in Section 103 of the Water Resources Development Act of 1986 (Public Law 99-662). The provisions require:

(1) The non-Federal interests to --

(A) pay 5 percent of the cost of the project during construction of the project; and

(B) provide all lands, easements, and rights-of-way and perform all related necessary relocations

(2) If the value of the contributions required above is less than 25 percent of the cost of the project, the non-Federal interest shall pay during construction of the project, such additional amounts as are necessary so that the total contribution of the non-Federal interests is equal to 25 percent of the cost of the project

(3) The non-Federal share under paragraph (1) shall not exceed 50 percent of the cost of the project. The preceding sentence does not modify the requirement of paragraph (1)(A).

(4) If the total amount of the contribution required under paragraph (1) exceeds 30 percent of the cost of the project, the non-Federal interests may pay the amount of the excess over a 15-year period (or such shorter period as may be agreed to by Federal and non-Federal interests) beginning on the date construction of the project or separable element is completed, at an interest rate determined pursuant to section 106 of the Act. The preceding sentence does not modify the requirement of paragraph (1)(A).

Section 106 provides that whenever a non-Federal interest is required or elects to repay an amount under the Act over a period of time, the amount to be repaid shall include interest at a rate determined by the Secretary of the Treasury, taking into consideration the average market yields on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the reimbursement period, during the month preceding the fiscal year in which costs for the construction of the project are first incurred (or in the case of recalculation the fiscal year in which the recalculation is made), plus a premium of one-eighth of one percentage point for transaction costs.

PROJECT RESPONSIBILITIES

Federal Responsibilities

a. Conduct advanced planning, engineering, and design studies.

b. Prepare plans and specifications.

c. Contract and supervise construction.

d. Conduct periodic inspection of the completed work with non-Federal interests to insure proper operation and maintenance.

Non-Federal Responsibilities

a. Provide 5 percent of the cost of the project assigned to flood control during construction of the project.

b. Provide all lands, easements, rights-of-way, and relocations necessary for construction, including all relocations and alterations of buildings, roads, highways, sewers, and utilities.

c. Prevent obstruction or encroachment which would reduce the flood carrying capacity of Mill Creek from the diversion structure to the Jordan River or hinder maintenance and operation, and control development in the project area to prevent undue increases in the flood damage potential.

d. Maintain and operate project facilities after completion of construction in accordance with regulations prescribed by the Secretary of the Army.

e. Hold and save the United States free from damages due to the construction and operation and maintenance of the completed works, except for damages due to the fault or negligence of the United States or its contractors.

f. Comply with the applicable requirements of "The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970" (PL 91-646).

g. Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

h. Make all necessary improvements to the I-9 storm drainage system to accommodate the proposed Federal plan of improvement. This may include construction of or contribution toward the construction cost of 26 acre-feet of storage at the Hillview site and an upper detention basin near 1500 East 4500 South Streets.

Cost Apportionment

The total cost for construction is estimated at $7,180,000. Non-Federal costs are estimated at $2,520,000, including the first cost of the lands, easements, and rights-of-way, estimated at $490,000, the cost of relocations, estimated at $1,670,000, and 5 percent of the cost of the project assigned to flood control estimated to be $360,000. Federal costs would be $4,660,000. The apportionment of project costs is summarized in Table 29. The total non-Federal contribution is about 35 percent of the total project cost. This satisfies the 25 percent (and 50 percent) provision of the Water Resources Development Act of 1986, and no additional cost-sharing adjustments are required. Local interests would be required to assume the total annual operation, maintenance, and replacement costs, currently estimated at $20,000.

PROCEDURES AND IMPLEMENTATION

Future actions necessary for authorization and construction of the proposed plan of improvement are summarized as follows:

- This report will be reviewed within the Corps of Engineers, including the South Pacific Division, the Board of Engineers for Rivers and Harbors, and the Office of the Chief of Engineers.

- The Chief of Engineers will seek formal review and comment by the Governor of Utah and interested Federal agencies.

- Following the State and agency review, the final report of the Chief of Engineers will be forwarded to the Assistant Secretary of the Army for Civil Works for forwarding to the Congress, subsequent to obtaining the views of the Office of Management and Budget regarding the relationship of the project to programs of the President.

- Congressional review of this feasibility report and possible authorization of the project would follow.

- Pending project authorization for construction, the Chief of Engineers could include funds, when appropriate, in his budget requests for continuing planning and engineering of the project. The objective is to ready the project for a construction start in the shortest possible time by maintaining the momentum established with the feasibility study.

- Following receipt of funds, continuing planning and engineering studies would be initiated, and surveys and detailed engineering designs would be accomplished.

- Following Congressional authorization of the project, plans and specifications would be accomplished by the District Engineer.

- Subsequent to appropriation of construction funds by the Congress but prior to construction, formal assurances of local cooperation would be required from non-Federal interests.

- Bids for construction would be invited and contracts awarded.

Following completion of construction, non-Federal interests would be responsible for operation and maintenance of the project.

It is not possible to project a schedule for the above steps because of the variables in the reviewing, advance planning, and funding for design and construction; it could be possible to complete design and project construction within a 3-year period if adequate funds are available.

VIEWS OF NON-FEDERAL INTERESTS

A list of all letters commenting on the Draft Feasibility Report and the Draft Environmental Impact Statement is shown in Table 37. Revisions and grammatical and typographical changes have been made to the draft feasiblity report and draft environmental impact statement and are not presented individually.

TABLE 37

LIST OF COMMENTS

FEDERAL AGENCIES	DATE
Department of the Interior, Office of Environmental Project Review	No Date
Department of Health and Human Services	1 June 1987
Department of Housing and Urban Development	10 June 1987
Department of Commerce, National Oceanic and Atmospheric Administration	11 June 1987
Environmental Protection Agency	11 June 1987
Soil Conservation Service	12 June 1987
STATE AGENCIES	
Department of Community and Economic Development, Division of State History	5 May 1987
Department of Natural Resources, Wildlife Resources Division	8 June 1987
Office of Planning and Budget	10 June 1987
CITY/COUNTY AGENCIES	
Salt lake County Public Works Department Flood Control and Highway Divisions	28 May 1987

FINANCIAL FEASIBILITY

The project sponsor will likely finance the local share of the project by applying a flood control tax against the assessed property value of the county. The projected 1987 assessed valuation of Salt Lake County is approximately $3.75 billion. It is evident that Salt Lake County can finance its share of the project with a minimum mill levy. The county is currently devoting mill levy funds to the repayment of a bond for financing restoration improvements for damages attributable to recent floods. This obligation will be satisfied in 1990, and the county would be in a position to finance the project in 1991.

DISTRICT ENGINEER'S DISCUSSION

In the interest of the public, I have reviewed and evaluated the information contained in the environmental statement; other documents concerning the Upper Jordan River; and views of other agencies, organizations, and individuals on economic, environmental, and other impacts of the plans for improvement of the Upper Jordan River. I have also reviewed the draft Detailed Report of Fish and Wildlife Service (FWS). Additional coordination will be conducted with FWS to develop recommendations acceptable to both agencies. In addition, I have personally inspected the project area and have participated in meetings with local Government officials, representatives of other agencies and organizations, and landowners and other concerned members of the public.

The possible consequences of constructing flood control improvements were studied and evaluated for environmental impacts, social and economic effects; engineering feasibility; compliance with executive orders and legal statutes; appropriateness for meeting the stated objectives of the investigations; and implementability.

General legislation authorizing implementation of water resources projects, the most recent being the Water Resources Development Act of 1986, contains local cooperation requirements. The basic principle governing the development of specific cost-sharing policies is that, whenever possible, the cost of services produced by water projects should be paid by their direct beneficiaries.

Under the financing and cost-sharing principles of the Water Resources Development Act of 1986, the level of non-Federal financial participation will be greater than in the past.

RECOMMENDATION

After giving careful consideration to the environmental, social, and economic effects; and engineering feasibility of all plans considered, I recommend that the plan selected herein for flood control be authorized for implementation as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable and subject to cost-sharing, financing, and other requirements of the Water Resources Development Act of 1986 for this kind of project. The Federal first cost of the project is presently estimated at $4,660,000. This recommendation is made with the provision that, prior to implementation, non-Federal interests will, in addition to the general requirements of law for this type of project, agree to comply with the following requirements:

a. Provide 5 percent of the cost of the project assigned to flood control during the construction of the project, currently estimated to be approximately $360,000.

b. Provide without cost to the United States all lands, easements, and rights-of-way including borrow areas and disposal areas for excavated material determined suitable by the Chief of Engineers and necessary for construction, operation, and maintenance of the project, currently estimated to cost $490,000.

c. Hold and save the United States free from damages due to construction and subsequent operation and maintenance of the project, except for damages due to the fault or negligence of the United States or its contractors.

d. Operate and maintain without cost to the United States all project works after completion in accordance with regulations prescribed by the Secretary of the Army at an estimated annual cost of $20,000.

e. Accomplish without cost to the United States all alterations and relocations of transportation facilities, storm drains, utilities, and other structures and improvements made necessary by the construction of the project, at an estimated cost of $1,670,000.

f. Prior to initiation of construction, prescribe and enforce regulations to prevent obstruction or encroachment which would reduce Mill Creek's flood-carrying capacity or hinder maintenance and operation, and control development in the project area to prevent undue increases in the flood damage potential.

g. Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

h. Comply with the applicable requirements of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970" (PL 91-646).

i. Make all necessary improvements to the I-9 storm drainage system to accommodate the proposed Federal plan of improvement. This may include construction of or contribution toward the construction cost of 26 acre-feet of storage at the Hillview site and an upper detention basin near 1500 East 4500 South Streets.

The recommendation contained herein reflects the information available at this time and current Departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program or prospective higher review levels within the Executive Branch. Consequently, the recommendations may be modified before transmittal to the Congress as proposals for authorization and/or implementation funding.

Wayne J. Scholl
Colonel, Corps of Engineers
District Engineer

FINAL

ENVIRONMENTAL IMPACT STATEMENT

UPPER JORDAN RIVER, UTAH

PREPARED BY

US ARMY ENGINEER DISTRICT, SACRAMENTO

July 1987

"INTERIM DOCUMENT UNDER AGENCY REVIEW - SUBJECT TO REVISION"

THIS DOCUMENT WILL BECOME THE FINAL ENVIRONMENTAL IMPACT STATEMENT WHEN IT IS FILED WITH THE U.S. ENVIRONMENTAL PROTECTION AGENCY AFTER REVIEW BY THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS AND THE OFFICE OF THE CHIEF OF ENGINEERS. THIS DOCUMENT WAS SUBMITTED TO SPD ON AUG 31 1987

FINAL
ENVIRONMENTAL IMPACT STATEMENT
UPPER JORDAN RIVER, UTAH

( ) Draft Environmental Impact Statement

(X) Final Environmental Impact Statement

Responsible Office: U.S. Army Engineer District, Sacramento
650 Capitol Mall
Sacramento, California 95814

1. Name of Action: ( ) Administrative (X) Legislative

2. Purpose: The purpose of this final environmental impact statement (EIS) is to describe the impacts of the proposed plan for flood control for the Upper Jordan River, Utah. This final EIS incorporates by reference information and displays discussed in the Feasibility Report for the Upper Jordan River, Utah.

Abstract: The Upper Jordan River reach under study extends from Jordan Narrows to 2100 South Street in Salt Lake County. Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek are major tributaries of the Jordan River within this reach, each with headwaters in the Wasatch Mountain Range. Each creek passes through different portions of the expanding urban and residential development of suburban Salt Lake City. Floods have been a recurring problem along each of these creeks and the Jordan River. Salt Lake County officials requested the Corps of Engineers assistance in studying flooding along these streams, including the development of alternative solutions. A number of alternatives for flood control were identified for each of the three creeks as well as for the Jordan River, involving various combinations of detention basins, channel improvements, non-structural measures, and no action. In 1982, 1983, and 1984, Salt Lake County experienced severe flooding. Consequently, the county has accelerated improvements to preclude repetition of damages. County voters approved a bond issue for flood damage repair and capital improvements to be accomplished during 1984 and 1985. In repairing flood damages and making improvements, the measures have been designed to accommodate the magnitude of flows experienced in 1983. Many of the measures are the same or similar to alternatives considered by the Corps for Mill Creek, Big and Little Cottonwood Creeks, and the Jordan River. Accordingly, no Federal action is proposed for Big and Little Cottonwood Creeks or the Jordan River; however, the county has requested that the Mill Creek portion of the investigation be completed. Implementation of alternatives would provide beneficial flood damage reduction to the human environment but would cause minor adverse impacts on the natural environment -- riparian and aquatic resources. The purpose of this environmental impact statement is to describe the environmental impacts of the proposed flood control plan on Mill Creek.

SEND YOUR COMMENTS TO THE BOARD OF ENGINEERS OF RIVERS AND HARBORS (Kingman Building, Environmental Division, Ft. Belvoir, VA 22066) BY (date: 30 days from transmittal date). If you would like further information on this EIS, please contact: Mr. Jeff Groska at the above address or telephone (916) 551-1860 or FTS 460-1860.

Final
Environmental Impact Statement
Upper Jordan River, Utah

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Appendix B: 404 (b)(1) Evaluation

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Appendix E: Letter from Division of State History on the Cultural Resources Survey of the Hillview Detention Basin Area.

Appendix F: List of Agencies, Organizations, and Individuals to Whom Notices of Availability Were Sent.

1.0 SUMMARY

1.1 Major Conclusions and Findings. - Four independent flood-prone areas were originally studied by the Corps, the Upper Jordan River and three tributaries: Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek. Periodic flooding on these streams is caused by rainstorms and snowmelt. Salt Lake County has expedited repairs of the 1983 flood damages and has accelerated capital improvements along Big Cottonwood and Little Cottonwood Creeks and the Jordan River and has also accelerated selected improvements on Mill Creek. Therefore, Federal action for flood control is limited to Mill Creek. Two major types of impacts associated with implementation of flood control improvements would be: (1) beneficial reduction of flood damages to the human environment and (2) adverse impacts on riparian and aquatic resources. Under the no action alternatives (i.e., no Federal flood control project) flooding would continue and natural resources would be adversely affected due to erosion and sedimentation. In addition, continued local development along the stream channel and tributary drainage area will intensify the flood problems and further degrade the resources.

The plan selected for potential implementation includes flood control features on upper Mill Creek which would complement existing and planned local flood control improvements. This plan is the national economic development, or NED, plan as it maximizes net benefits while protecting the Nation's environment. The plan has a benefit/cost ratio of approximately 1.3, and a first cost currently estimated at $7,180,000, including a cost to the United States of $4,660,000, and a cost of $2,520,000 to non-Federal interests. Estimated annual benefits resulting from the plan are $894,000 and the estimated average annual costs $672,000. The major features include a diversion dam, located about 200 feet above Highland Drive, and a 7,440-foot-long, 84-inch-diameter conduit and a 74 acre-foot enlargement to the Hillview Detention Basin. The diversion dam is designed to bypass Mill Creek flows up to 200 cfs to the existing stream channel and to divert up to 750 cfs into the conduit for conveyance to the Hillview Detention Basin. The diversion dam would be a gated concrete structure having a width of about 55 feet and an overall length of 155 feet including transition sections. A side channel flume would direct the diverted flows into the conduit. Diversions would be regulated by a manually operated slide gate. The conduit extending from the diversion structure to the Hillview Detention Basin would be reinforced concrete and would be placed under public streets. The conduit would outlet into the Hillview Detention Basin. The Hillview Detention Basin will initially be constructed by local interests to a capacity of about 26 acre-feet to regulate floodflows collected and conveyed by a local storm drain system. As a part of the project plan, the detention basin would be enlarged by 74 acre-feet to provide a total storage area of 100 acre-feet for regulating diversions from Mill Creek up to a 100-year flood. Controlled releases from the basin would be made through a storm drainage system into Big Cottonwood Creek. Although the initial Hillview Detention Basin and downstream conduit to Big Cottonwood Creek have not yet been constructed, local interests plan to do so in the near future. These facilities are considered as existing, or in other words as the preproject condition.

1.2 Areas of Controversy. No areas of controversy have been identified.

1.3 Unresolved Issues. There are no unresolved issues.

1.4 Relationship to Environmental Requirements. The relationship of each alternative to Federal, State, and local environmental law, executive orders, and other policies is given in Table 1. The relationship of the selected plan to environmental requirements is discussed in detail below.

(1) National Historic Preservation Act of 1966, and the Historical and Archeological Data Preservation Act of 1974. - Partial Compliance. Information collected to date is described in paragraphs 5.5 and 6.2. The Hillview Detention Basin is the only project feature that has been the subject of an intensive cultural resources survey. That effort failed to reveal any extant cultural sites, but the Utah State Historic Preservation Officer has requested that construction activity be monitored due to both poor ground visibility during the survey and the fact that a Fremont period site was, despite heavy urban development, recently discovered in downtown Salt Lake City (Appendix E). If a project is authorized, an intensive cultural resources survey of the remaining project features will be conducted and, pursuant to the requirements of the National Historic Preservation Act of 1966 and its implementing regulations contained in 36 CFR 800, all necessary consultation and mitigation completed before project implementation.

(2) Clean Air Act. - Partial compliance. Federal, State, and local air requirements will be included in detailed design studies after project authorization and coordinated with the concerned agencies to ensure compliance with the State Implementation Plan for air quality. Filing of the EIS and Record of Decision with the Environmental Protection Agency will complete the process and bring the plan into full compliance.

(3) Clean Water Act. - Partial compliance. An evaluation in accordance with Section 404(b)(1) of the Clean Water Act (33 USC 1344) has been prepared and attached as Appendix B. Processing of this EIS to Congress is in accordance with Section 404(r) of the Act. Completion of these processes would bring the plan into full compliance.

(4) Coastal Zone Management Act. - Not applicable. The project area is not within the coastal zone.

(5) Endangered Species Act. - Full compliance. The U.S. Fish and Wildlife Service (FWS) has determined that no Federally listed or proposed threatened or endangered species are known to occur within the project area. See Appendix B.

(6) Estuary Protection Act. - This act is not applicable to the study area.

(7) Farmland Protection Act of 1982. - Full compliance. No known farmland would be affected by this project. See Appendix D. This EIS is being coordinated with Soil Conservation Service (SCS) in compliance with the Act.

(8) Federal Water Project Recreation Act. - Full compliance. There are no opportunities for recreation development and use of the proposed flood control facilities.

(9) Fish and Wildlife Coordination Act. - Full compliance. The FWS has provided a Final Coordination Act Report, and this is included in Appendix C.

TABLE 1
Relationship of Alternatives to Environmental Requirements

Federal Statutes:	No Action	Channel Improvement	Diversion and Conveyance
Historical and Archaeological Data Preservation Act of 1974, as amended, 16 U.S.C. 469 et seq.	FC	NC	PC
Clean Air Act, as amended, 42 U.S.C. 7401, et. seq.	FC	PC	PC
Clean Water Act as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251, et. seq.	FC	PC	PC
Coastal Zone Management Act, as amended 16 U.S.C. 1451, et. seq.	N/A	N/A	N/A
Endangered Species Act, as amended 16 U.S.C. 1531, et. seq.	FC	FC	FC
Estuary Protection Act, 16 U.S.C. 1221, et. seq.	N/A	N/A	N/A
Farmland Protection Act	FC	FC	FC
Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1 (12), et. seq.	FC	FC	FC
Fish and Wildlife Coordination Act, as amended, U.S.C. 661, et. seq.	FC	FC	FC
Land & Water Conservation Fund Act, as amended, 16 U.S.C. 4601-11, et. seq.	N/A	N/A	N/A
Marine Protection Research & Sanctuaries Act, 22 U.S.C. 1401, et. seq.	N/A	N/A	N/A
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470, et. seq.	FC	NC	PC
National Environmental Policy Act (NEPA) as amended, 42 U.S.C. 4321, et. seq.	FC	PC	PC
Rivers & Harbors Act, 33 U.S.C. 401, et seq.	FC	FC	FC
Watershed Protection & Flood Preservation Act 16 U.S.C. 1001 et. seq.	N/A	N/A	N/A
Wild & Scenic Rivers Act, as amended, 16 U.S.C. 1271, et. seq.	FC	FC	FC
Executive Orders, Memoranda:			
Flood Plain Management (E.O. 11988).	FC	FC	FC
Protection of Wetlands (E.O. 11990)	FC	FC	FC
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	N/A	N/A	N/A
Local Policies:			
Salt Lake County General Plan	FC	FC	FC

NOTES: The compliance categories used in this table were assigned based on the following definitions related to the present stage of planning:

a. Full compliance (FC) - All requirements of the statute, E.O., or other policy and related regulations have been met.
b. Partial compliance (PC) - Some requirements of the statute, E.O., or other policy and related regulations remain to be met.
c. Noncompliance (NC) - None of the requirements of the statute, E.O., or other policy and related regulations have been met.
d. N/A - Statute, E.O., or other policy not applicable.

(10) Land and Water Conservation Fund Act (LWCFA). - Not applicable. No lands or facilities for recreation provided with funds pursuant to this act would be involved with the project.

(11) Marine Protection Research and Sanctuaries Act. - Not applicable. The project would not affect any marine sanctuary.

(12) National Environmental Policy Act (NEPA). - Partial compliance. This FEIS has been prepared in accordance with NEPA regulations issued by the Council on Environmental Quality and Engineer Regulation 200-2-2. Filing of the Final EIS and Record of Decision with the Environmental Protection Agency would complete the process and result in full compliance.

(13) Rivers and Harbors Act. - Full compliance. The Selected Plan would not obstruct navigable water.

(14) Watershed Protection and Flood Prevention Act: - Not applicable.

(15) Wild and Scenic River Act. - Full compliance. The proposed plan would not affect any designated wild and scenic river area under this Act, nor any wild and scenic area listed in the National Inventory prepared by the Department of the Interior.

(16) Flood Plain Management (EO 11988). - Full compliance. Executive Order 11988 requires the following: (1) avoid development in the base (100-year) flood plain unless it is the only practicable alternative; (2) reduce the hazards and risk associated with floods; (3) minimize the impact of floods on human safety, health, and welfare; and (4) restore and preserve the natural and beneficial values of the base flood plain. The Corps has examined these requirements and determined that the proposed project would minimize adverse impacts associated with the use of base flood plain and complies with the intent of EO 11988.

(17) Protection of Wetlands (EO 11990). - Full compliance. No wetlands would be affected.

(18) Environmental Effects Abroad of Major Federal Action (EO 12114). - Not applicable.

(19) Salt Lake County General Plan. - Full compliance. The Salt Lake County General Plan includes a system of existing and proposed storm drains, associated Detention Basins, and channel plans for reduction of flood hazard in the area. The proposed project is compatible with this plan.

2.0 NEED FOR PROJECT AND OBJECTIVES OF ACTION

2.1 Study Authority. The basic authorization for this investigation is contained in Section 6 of the 1938 Flood Control Act, which authorized studies of flood problems on streams draining into the Great Salt Lake and the Great Basin of Utah and Nevada. In October 1960, the Chief of Engineers authorized investigation of the Jordan River Basin, and in March 1979 South Pacific Division, Corps of Engineers approved interim investigation of the Upper Jordan River area.

2.2 Public Concerns. Public concerns are primarily related to the need for increased flood protection in the Salt Lake City area, including Mill Creek.

2.3 Study Objectives. The investigation has been conducted in cooperation with Salt Lake County to serve as a basis for determining flood control measures which can best be implemented by local interests and those which qualify for consideration as a Federal project. The primary objective is to develop flood control improvements to reduce urban damages to developments within the Mill Creek flood plain consistent with the local flood control plans. Additional objectives are to preserve and enhance environmental values such as wetlands and fish and wildlife resources and to include water conservation measures to the extent practical.

3.0 ALTERNATIVES

This section presents the various alternative plans evaluated. It identifies those alternative plans which have been eliminated, presents the plans studied further, and the plan recommended for implementation. A description of the various plans is presented in more detail in the Feasibility Report. Included herein are comparative impacts associated with plans being considered further. A detailed description of potential impacts and possible mitigation measures is included in Section 6.

3.1 Plans Eliminated from Further Study. Alternative flood control plans were developed for portions of the four study area streams as shown below.

Stream	Study Reach
Mill Creek	Jordan River to Wasatch Boulevard (8.5 miles)
Big Cottonwood Creek	Jordan River to Wasatch Boulevard (10.2 miles)
Little Cottonwood Creek	Jordan River to Wasatch Boulevard (11.0 miles)
Jordan River	2100 South Street to Jordan Narrows (21.0 miles)

A broad array of flood control alternatives were initially developed and evaluated for each stream. The evaluation included flood protection afforded, economic feasibility, and the plans of local interests. Based on the evaluation, many of the plans were eliminated from further consideration. The alternatives eliminated and results of the assessment are shown in Table 2. As noted, local interests have implemented improvements on Big Cottonwood Creek, Little Cottonwood Creek, Mill Creek, and Upper Jordan River. The early implementation of these plans was brought about as a result of the 1982, 1983, and 1984 floods and subsequent availability of funds through a local bond issue.

3.2 Plans Considered in Detail. The alternative plans considered in detail are limited to two reaches of Mill Creek, the upper reach extending from 200 feet above Highland Drive to 1300 East Street and the lower reach extending from State Street downstream approximately 5,700 feet to 900 West Street, and include the No Action Plan, channel improvement along the lower reach, and two diversion/conveyance plans in the upper reach. These alternatives considered in detail are described below.

3.3 No Action Plan. No action would be taken by the Federal Government to participate in resolving flood and related problems. Without the implementation of additional measures to complement local interest plans, flooding will recur at more frequent intervals as development in the tributary area continues. The floods will impact on streamside urban-related developments and will also affect stream habitat, riparian vegetation, and the floodplain esthetics.

3.4 Mill Creek Channel Modification. Under this plan channel improvements would be provided along the lower reach of Mill Creek, on a 5,700-foot reach extending from 900 West Street to State Street. The channels would be enlarged to safely convey flows up to the 100-year magnitude. The

Table 2
Reasons for Elimination of Alternatives

Stream	Plan	Inadequate Flood Protection	Economically Infeasible	Notes
Mill Creek	Nonstructural	X	X	
	Channel Improvement (8.5 miles)		X	
	Channel Improvement (4.0 miles)	X	X	
	Parkway (Skyline - Hillview & Scotts Det.)		X	
	Parkway, Hillview, & Scott Det.)		X	
	Detention Basins			
Big Cottonwood Creek	Nonstructural	X	X	
	Channel Improvement (10.2 miles)		X	
	Channel Improvement/Nonstructural		X	
	Intermittent Channel Improvement 100-year		X	
	Parkway		X	
	Intermittent Channel Improvement 50-year*			* Implemented by local interest
Little Cottonwood Creek	Nonstructural	X	X	
	Channel Improvement (11.0 miles)		X	
	Channel Improvement/Nonstructural		X	
	Parkway		X	
	Detention Basin	X		
	Detention Basin/Intermittent Channel Improvement*			* Implemented by local interest
Upper Jordan River	Nonstructural	X	X	
	Parkway		X	
	Multiple-Purpose Storage		X	
	Intermittent Channel Improvement*			* Implemented by local interest

improvements would include bridge modifications, channel invert modifications, channel enlargement, and/or provision for a more effective conveyance system by a grouted rock lining or a flume section. Channel improvement measures would vary depending upon available open area adjacent to the streams, the erosion potential, cost effectiveness, and environmental effects.

Although the lower Mill Creek improvements complement local interest plans, they are economically infeasible and have been dropped from further consideration.

3.5 Mill Creek Diversion and Conveyance. Within the upper reach of Mill Creek two alternative diversion sites and conveyance alignments were studied. Under these alternatives, floodflows would be diverted from Mill Creek to the Hillview Detention Basin by means of a diversion dam and conduit. The diversion dam would be a gated concrete structure having a width of about 55 feet and an overall length of 155 feet including transition sections. A debris basin, approximately 20,000 cubic feet in volume, would be incorporated into the diversion structure to accommodate and prevent debris and sediment from clogging and impairing the discharge capacity of the diversion structure. The diversion structure would permit the passage of up to 200 cfs into Mill Creek, but would divert flows in excess of 200 cfs and have the capacity to divert up to 750 cfs into the conduit. As a preproject condition under these two alternatives, the Hillview Detention Basin will be constructed by local interests to a capacity of about 26 acre-feet to regulate floodflows collected by a local storm drain system. As a part of the project plan, the Detention Basin would be enlarged by 74 acre-feet to provide storage for regulating diversions from Mill Creek up to a 100-year flood. The spillway and levees would be designed to pass the probable maximum flood (PMF). Plates accompanying the Feasibility Report depict these two alternatives, which are described below.

Diversion at 1300 East Avenue. Under this alternative the diversion structure would be located just upstream of 1300 East Street, and diverted flows would be conveyed through 6,170 lineal feet of reinforced concrete conduit to Hillview Detention Basin. This alternative also includes 1,580 lineal feet of channel improvements from 1300 East Street to approximately 200 feet upstream of Highland Drive. The pipeline route lies along the east side of 1300 East Street from Mill Creek to 4085 South Street, along the south side of 4085 South Street to 1100 East Street, and along the west side of 1100 East Street to the edge of the Hillview Detention Site. After regulation by Hillview Detention Basin, stored water would be conveyed via conduit to Big Cottonwood Creek. The plan would minimize relocation of existing utilities.

Diversion above Highland Drive - (Selected Plan). In this alternative the diversion structure would be located 200 feet above Highland Drive. Water diverted at the Highland Drive diversion structure would be conveyed by 7,440 lineal feet of conduit from Mill Creek to the Hillview Detention Basin. The route begins 200 feet upstream of Highland Drive, parallels the existing Mill Creek channel before crossing Highland Drive and continues down the south side of Murphys Lane to 1300 East Street, then follows the same alignment to the Hillview Detention Basin as described for the alternative diversion at 1300 East Avenue. Controlled releases would be conveyed to Big Cottonwood Creek as described above. Mitigation measures coordinated with the U.S. Fish and Wildlife Service for the selected plan consist of revegetating unstabilized banks and disturbed and exposed areas associated with construction of the diversion structure and enlargement of Hillview Detention Basin.

The alternative to divert water at the site above Highland Drive was selected because it was found most cost effective and provided the least amount of impact to riparian and aquatic resources. The selected plan would not have any significant adverse effects on the I-9 Ditch or Big Cottonwood Creek because water held in the Hillview Detention Basin can be released under controlled conditions.

3.6 Comparative Impacts. Table 3 provides a summary of the impacts of the Selected Plan, No Action, and other alternatives.

TABLE 3

MILL CREEK: COMPARATIVE IMPACTS OF ALTERNATIVES

Base Condition and Alternatives	Vegetation	Fisheries	Reduce Flood Hazard	Wildlife	Plan Economics
Base Condition (No Action)	No change Scattered areas of riparian along stream	No change Limited fishery along 6 miles of stream	Continued flooding; 10-to 50-year flood protection	No Change Limited wildlife habitat	Costs: $0 Net Benefits: $0 BCR: $0
Channel Improvements	Most riparian disturbed or removed along approx. 5,700 feet of stream	Approx. 6,000 feet of fish habitat degraded	Reduced flood hazard; 100-year flood protection	Short-term dislocation of wildlife inhabiting riparian areas until revegetation	Annual Costs:$285,000 Annual Benefits: $60,000 BCR:0.2 Oct 1984 price level
1300 East Avenue Diversion and Conveyance Plan 1/	Riparian removed along 1,580 feet of channel, 0.3 acre loss at diversion site and loss of upland vegetation at the detention basin	Approx. 1,580 feet of fish habitat degraded Blockage to fish migration	Reduced flood hazard; 100-year flood protection provided to most of Mill Creek flood plain	Dislocation of wildlife inhabiting riparian areas. Short-term decrease with revegetation	Annual Cost:$763,000 Annual Benefits: $894,000 BCR: 1.2 Oct 1984 price level
Highland Drive Diversion and Conveyance Plan 2/ (Selected Plan)	Loss of 0.3 acres at the diversion site and loss of upland vegetation at the detention basin	Minor short-term disturbance of fish habitat during construction. Blockage to fish migration	Reduced flood hazard; 100-year flood protection provided to most of Mill Creek flood plain	Little or no change. Revegetation at diversion site and in disturbed areas of Detention Basin	Annual Cost:$672,000 Annual Benefits: $894,000 BCR: 1.3 Oct 1986 price level

1/ This alternative includes 1,580 feet of channel work.

2/ This alternative does not include channel work.

4.0 NON-SIGNIFICANT RESOURCE CONDITIONS AND ENVIRONMENTAL SETTING

The following are environmental resources which are not considered significant with respect to impacts of the Upper Jordan River project.

4.1 Topography, Geology, and Soils. - Salt Lake Valley in North-Central Utah is a remnant of the great inland sea, Lake Bonneville, that once covered vast areas of the Great Basin during the Pleistocene Epoch. Great Salt Lake and Utah Lake are the last remaining basins of this ancient sea that still contain water. The valley is bordered on the west by the Oquirrh Mountains and in the east by the rugged, faulted and folded Wasatch Front. To the south of the Salt Lake Valley lie the Traverse Mountains and Utah Lake; to the north is the Great Salt Lake. The Wasatch Mountain Range is a physiographically distinct range which comprises the western edge of the Rocky Mountains and the eastern border of the Great Basin. The terrain rises from 4,200 feet on the valley floor to elevations of over 11,000 feet.

The Jordan River Basin lies within two physiographic provinces; the portion of the basin east of the foot of the Wasatch Mountains is part of the Middle Rocky Mountain physiographic province, whereas the remainder of the basin is part of the Basin and Range province. The Middle Rocky Mountain portion of the Jordan River Basin includes both the Wasatch Mountains which are the source of all the streams that discharge from the east directly into Jordan and Utah Valley, and the Western Uinta Mountains, which are drained by the headwaters of the Provo River. The Wasatch Mountains are a faulted and uplifted block composed of a wide variety of rock types and ages.

Soils of the study area are highly diverse and reflect the range in geology, elevation, slope, and climate. Soils surrounding and underlying Great Salt Lake, portions of Utah Lake, and poorly drained valley areas are heavy clay textured, high in organic content, low in density, and high in alkali. Soils located on the higher terraces consist primarily of sands, silts, and clays. Soils in the mountain valleys are commonly shallow, coarse textured, and well-drained and are composed of gravels and boulders from glacial activity, stream erosion, and landslides. Salt and alkali rich soils predominate the lower portion of the Jordan Valley; problems of soil balance prevent agricultural cultivation and the level of landscaping desirable for residential landscaping but do not prevent industrial development. Due to lacustrine deposition of most surface material in Jordan Valley, clay horizons and layers are common at various depths and thicknesses. These clay layers result in problems of shrink-swell, drainage related to high water tables, and runoff. Soils adjacent to the Jordan River, regardless of their texture or horizontal character, may experience a high water table. In general, soils of the Jordan River flood plain have soils of the lacustrine terraces that are attractive to development and overall land use conversion but have poor drainage and foundation conditions that are often flood prone.

4.2 Hydrology. - All major tributary streams in the Jordan River Basin south of Jordan River Narrows discharge into Utah Lake after their flows have been depleted by numerous diversions for irrigation and municipal and industrial uses. Between Utah Lake and Salt Lake City, the Jordan River gains substantial quantities of water by seepage from the saturated valley fill, as well as by inflow from tributaries, and it loses water by numerous diversions. About 85 percent of the streamflow from the Wasatch Range within

Salt Lake County is included in the flows of the seven streams, Red Butte, Little Cottonwood, Big Cottonwood, Mill, Parleys, Emigration, and City Creeks. The flows vary greatly from month to month and also from year to year. Melting snow during the spring or early summer produces a large part of the annual flow, and seepage from the ground produces a smaller but more uniform flow. About two-thirds of the total flow in the seven streams is in Little Cottonwood and Big Cottonwood Creeks.

In the Salt Lake County part of the Wasatch Range, all but the smallest streams are used for municipal, industrial, or irrigation supplies, and some are used for all three.

Floodflows in the meteorological region of Jordan River have resulted from rapid melting of mountain snowpack and from cloudbursts and general rainstorms. Snowmelt floods occur during spring. General rain floods can occur at any time of the year, but generally occur in the fall and spring (US Army Corps of Engineers, 1970). The most severe cloudburst storms in the vicinity of Salt Lake Valley have occurred between May 15 and September 15. Snowmelt flows in excess of channel capacities usually occur about once in ten years. Such high flows may persist for several days or weeks. Floodflows from Mill Creek flood commercial and residential areas between Highland Drive and State Street and commercial and industrial facilities west of State Street to the Jordan River. Bank overflows temporarily pond until carried by surface drainage facilities and storm drains.

4.3 Climate. - Annual precipitation in the basin varies from approximately 12 inches on the lowest part of the valley floor to approximately 20 inches at the base of the Wasatch Mountains, and up to approximately 60 inches in the high mountain areas. During the period October through May, precipitation generally falls as snow, although rain often occurs in the valley areas. Rainfall accounts for most of the precipitation during the remainder of the year. Temperatures in the valley areas of the basin range from -30 degrees F to 105 degrees F, with temperatures above the valley floor 3 to 4 degrees lower per thousand feet rise in elevation.

4.4 Water Quality. Mill Creek generally has good water quality in upstream canyon reaches, but poor water quality downstream within the study reach. Quality varies depending on the extent of recreation activity and residential development. Historically, water has been diverted near the canyon mouth for municipal, industrial, and irrigation uses. Presently, municipal diversions are not made due to a lack of adequate treatment facilities. Concentrations of coliform, nitrate and phosphorus nutrients, and BOD are high; and erosion and turbidity add to the poor water quality in downstream reaches (see Table 4). See Appendix B, 404(b)(1) Evaluation for further information.

4.5 Air Quality. Ambient air quality in the Salt Lake County municipal and industrial service areas has been classified as "in attainment" of National standards for nitrogen dioxide. "Non-attainment" status has been designated in areas in the county for total suspended particulate (TSP) and carbon monoxide (CO). Salt Lake County has been designated a non-attainment area due to exceedence of National Standards for sulfur dioxide (SO_2) and ozone. Salt Lake City has been designated a non-attainment area for carbon monoxide. Transportation sources account for most of the CO emissions and over one-half of the particulates and most of the sulfur dioxide emissions in the county.

Table 4
Mill Creek Water Quality Parameters

	Total Dissolved Solids (mg/l)	Total Coliform (MPN/100 ml)	Dissolved Nitrate (mg/l)	BOD_5 (mg/l)	DO (mg/l)
At Canyon Mouth	336-400	30-2300	0.04-0.33	(<1.0)-5.5	7.0-8.8
At Jordan River Confluence	327-834	230-21000	0.07-3.00	(<1.0)-10.0	7.1-8.8
Near 1100 East St	670-986	1500-24000	0.15-0.33	2.0-9.9	6.8-8.1

Source: "Assessment of Salt Lake Valley Tributaries: Recreational Use Impairment and Opportunities", Division of Flood Control And Water Quality, July 1985.

4.6 Socioeconomics. The population of Salt Lake County, about 700,000, accounts for 42 percent of the total State population of about 1,600,000 (1986). The growth rate of the population has increased over 3 percent per year during the past decade. The growth rate from 1980 to 1985 was about 2.5 percent per year. The total number of housing units in Salt Lake County has increased 53.7 percent for the decade, or 4.4 percent annually. Salt Lake County has a total of about 489,000 acres, of which 122,000 are presently developed for urban and suburban uses; about 71,000 acres are for agriculture, and about 94,000 are undeveloped, mountainous, marsh, and desert areas. Land use changes from 1970 to 1986 have primarily been associated with urbanization to accommodate population growth, commercial and industrial expansion, and associated supporting developments. The Salt Lake metropolitan area, often referred to as the "Crossroads of the West," serves as an intermountain center for business, commerce, education, communication, and transportation.

4.7 Recreation. Recreation developments have historically lagged behind population growth. Urbanization is continuing at a rate in excess of recreation facilities development, and sites that are suitable for recreation development are in short supply. The following are examples of recreation facilities needed in the Mill Creek vicinity: snowmobiling staging areas, trailbike trails and staging areas, general winter activity areas and facilities, hiking trails, camping units, picnic units, and support facilities.

5.0 AFFECTED ENVIRONMENT AND SIGNIFICANT RESOURCE CONDITIONS

This section briefly describes the significant resources of the upper Jordan River and tributaries. Resource conditions considered significant include flooding, vegetation, fisheries, wildlife, and cultural resources, all of which are described in paragraphs 5.1-5.5. Mill Creek is the only stream on which a project is being proposed for Federal implementation. Mill Creek originates in the Wasatch Mountains in the south part of Salt Lake City, and traverses suburban areas and valley lands en route to the Jordan River.

5.1 Flooding. - Jordan River and tributary streams have a long history of flood and water related socioeconomic problems. Flood problems have intensified with time due to encroachment of flood plains by increased urban and suburban development. Flood control measures have lagged behind growth and development. Flooding is closely associated with spring snowmelt and spring and summer rainstorms. Presently, intense floodflows carrying debris and sediments can escape the stream channel at Highland Drive and several other locations along Mill Creek.

5.2 Vegetation. - Mill Creek from the Jordan River upstream to the canyon mouth extends through urban Salt Lake City and consists primarily of ornamental vegetation. Native vegetation of the riparian river bottom community includes cottonwoods, willows, and smaller woody species. The understory is dominated by grasses. Overall, bank stabilization and shading is poor except where residential property owners maintain vegetation cover. There are no endangered species of vegetation within the Jordan Valley flood plains.

5.3 Fisheries. - The Utah Department of Water Resources (Utah DWR) has divided Mill Creek into four sections for purposes of description and classification. Section one, which extends from the mouth of Mill Creek to Scott Avenue, is classified by the department as a Class IV (limited fishery resource) fishery. Section two extends from Scott Avenue to 2300 East Street and is classified as a Class VI (periodically dewatered) fishery. The remaining upstream sections are classified as Class III (moderate value fishery resource). The project alternatives considered for Mill Creek are all contained within section one and the lower portion or section two. The limited fishery of the study area is attributed to the poor water quality, little shading, and dewatering during the winter months. Resident fish in Mill Creek from the Jordan River upstream to the canyon mouth include rainbow trout, brown trout, carp, longnose dace, Utah sucker, mountain sucker, and walleye. No endangered or threatened species of fish are found in the area. Angling pressure along the study area comes primarily from children. The Utah DWR suggests that with guaranteed minimum flow and water quality improvement a valuable fishery could be established along with other recreation opportunities.

5.4 Wildlife. - Terrestrial wildlife along the Mill Creek is dominated by a diverse variety of birds including the belted king-fisher, robin, and goldfinch. Shorebird and waterfowl use is minimal due to limited aquatic plant growth and poor water quality. Mammals found in the undisturbed riparian zone include muskrat, ground squirrel, and cottontail rabbit. Several species of reptiles, largely lizards and a few non-poisonous snakes, are also found in the area. Coordination with the Fish and Wildlife Service indicates no known threatened or endangered species within the study area (Appendix C).

5.5 Cultural Resources. The Jordan River area of the eastern Great Basin has been the scene of human occupation for at least the past 10,000 years. The intervening time until the arrival of Anglo-Europeans has, based upon anthropological data, been divided into three periods, each representing either different cultures or cultural adaptations to the area. A cultural resources overview of the project area was completed in 1984 (Janetski 1984). That study indicated the presence of one prehistoric and one historic period site within 1/4 mile of Mill Creek. The Hillview Detention Basin is the only project feature that has been subjected to an intensive cultural resources survey. The effort failed to locate any extant cultural values, but the Utah State Historic Preservation Officer (SHPO) has requested on-site monitoring during construction activity in this area (Appendix E). If project implementation is approved, cultural resources surveys of the remaining project features will be completed in the advanced planning stages of the project and the requirements of both the National Historic Preservation Act of 1966, as amended (16 USC 470) and Title 36 Part 800 of the Code of Federal Regulations will be met prior to project implementation. Impacts to encountered sites, if any, will be avoided if possible. If impact avoidance is not feasible, appropriate mitigative/protective measures will be developed and implemented in accordance with the above referenced laws and regulations.

6.0 ENVIRONMENTAL EFFECTS

This section briefly describes the effects of Diversion and Conveyance Plans and the No Action Plan on flooding, vegetation, fisheries, cultural resources, and wildlife of Mill Creek. Other alternatives were determined to be infeasible as shown in Table 2 and therefore are not included in the discussion below. As described below, impacts to fish and wildlife would be greater with a diversion at 1300 East Avenue than above Highland Drive.

6.1 No Action. -

Flooding. - With no action, flooding on Mill Creek will continue with increasing intensity and frequency based on past trends and future development within the flood plain and watershed.

Vegetation. - The No Action Plan would enable the riparian and other vegetation of Mill Creek to continue as it presently exists.

Fish. - The limited fishery resources of Mill Creek are expected to slightly decrease in abundance and quality in the future under the No Action Plan due to increased floodflow conditions.

Wildlife. - The No Action Plan would continue the limited wildlife resources of Mill Creek in the proposed project area essentially as they exist now.

6.2 Diversion above Highland Drive (Selected Plan).

Flooding. - The diversion and conveyance plan would provide a 100-year level of protection from rain floods from Highland Drive to State Street and would permit passage of snowmelt floods well above the 500-year flood. The potential diversion and conveyance features of the plan would complement local interests' flood control measures. The 100-year flood peak of 1,370 cfs at Highland Drive would be reduced to 620 cfs below the diversion structure. The reduced flow would essentially be contained in the 540 cfs channel capacity for the reach extending from Highland Drive to Scott Avenue. At 700 East the local interest diversion would reduce the 100-year flow from 970 cfs to 200 cfs and provide sufficient regulation to reduce the flow at State Street from 1,080 cfs to 720 cfs. The reduced flow would be contained within the channel carrying capacity from 700 East Street to State Street. Below State Street the 100-year floodflow would be reduced to about 720 cfs and would result in reduced overbank flooding but would not provide control consistent with the 300 cfs capacity channel. The proposed project would reduce erosion, sedimentation, and other effects of floodflows.

Vegetation. - With the Selected Plan, the diversion and conveyance facilities would permanently displace about 0.3 acre of vegetation at the diversion site. Mitigation would occur by revegetation of unstabilized banks associated with the construction. No other riparian vegetation would be disturbed. Periodic flooding of the Detention Basin will displace upland vegetation and facilitate invasion of water tolerant species. Revegetation plantings consisting of trees, shrubs, grasses, and forbs would be provided in the Detention Basin in areas of disturbed and exposed soil as recommended by the Fish and Wildlife Service to aid in the reestablishment of songbirds and small mammals displaced by construction activity (see Appendix C, letter dated 5 June 1986). The conduit would be located along street alignments with no impacts on vegetation.

Fish. - Under the diversion and conveyance plan, excess floodflows will be bypassed at the diversion dam and could, according to the Fish and Wildlife Service (FWS), cause detrimental effects to fish at Mill Creek (Appendix C). During operation of the completed project, the filling and draining of the Hillview Detention Basin during floodflow conditions could cause stranding of fish which may enter the collector systems and basin during high flow. However, the FWS has indicated this section of stream, in the area of the diversion structure, has limited fishery value due to the lack of a resident fishery and complete dewatering during the winter months. Additionally, water would likely be diverted only once or twice a year during major rainstorm events when flows exceed 200 cfs, and only for short periods of time. Therefore, the operation of the diversion structure is not anticipated to have a significant impact on fish. A fish screen could be added during the post-authorization phase if found needed by Federal and State resource agencies, and deemed justified by the Corps. In addition, with the diversion structure presently planned, no design measures have been included to allow fish migration through the structure. Because of the poor quality of the fishery within the reach (Class 6 - periodically dewatered) costly fishways and other similar structural measures were not determined to be justified.

With a reduction in floodflows, erosion, sedimentation, and debris would be reduced in the 5-mile reach of Mill Creek below the diversion dam. Therefore, in the long-term it is anticipated that fish habitat will be improved with this improvement in water quality.

Wildlife. - To reestablish wildlife populations that may become dislocated during construction, the Detention Basin would be revegetated as described in paragraph 6.2 subparagraph vegetation. No significant impacts to wildlife from the Selected Plan are anticipated.

Other Impacts. - The placement of 7,440 lineal feet of conduit along residential and secondary streets will temporarily disrupt traffic patterns during the period of construction. Temporary increases in noise, traffic congestion volumes, and in local concentrations of air pollution contaminants would occur as a result of construction activities; existing conditions would return upon project completion. The Hillview Detention Basin is the only project feature that has been the subject of an intensive cultural resources survey. That investigation did not locate any cultural resources sites. Due to the presence of heavy ground cover during the survey, the Utah State Historic Preservation Officer (SHPO) has requested on-site monitoring during the initial phases of construction at this location. If project implementation is approved, cultural resources surveys of the remaining project features will be completed in the advanced planning stages, and the requirements of both the National Historic Preservation Act of 1966, as amended (16 USC 470) and Title 36 Part 800 of the Code of Federal Regulations will be met prior to project implementation. Impacts to encountered sites, if any, will be avoided if possible. If impact avoidance is not feasible, appropriate mitigative/protective measures will be developed and implemented in accordance with the above referenced laws and regulations.

6.3 Diversion at 1300 East Avenue.

Flooding. - This alternative would have an identical effect on flooding as described for the Selected Plan in paragraph 6.2.

Vegetation. - As in the Selected Plan, 0.3 acre of vegetation would be permanently displaced at the diversion site. However, channel improvements included in this alternative would cause the removal of riparian along 1,580 feet of Mill Creek. The riparian loss associated with this channel work would require a significant amount of mitigation. All other impacts to vegetation are identical to the Selected Plan described in paragraph 6.2.

Fish. - Unlike the Selected Plan, this alternative would degrade fish and aquatic habitat along approximately 1,580 linear feet of stream associated with channel improvements. Other impacts of this alternative are identical to the Selected Plan described in paragraph 6.2.

Wildlife. - The loss of riparian habitat for songbirds and other wildlife species associated with the channel improvements of this alternative would cause the dislocation of wildlife to areas providing this habitat type. Because of the low availability of wildlife habitat in the study area, riparian-dependent or sensitive wildlife populations would be adversely affected. Mitigation plantings would be needed to prevent a long-term decline in abundance of riparian dependent species in the study area. Other impacts are identical to the Selected Plan described in paragraph 6.2.

Other Impacts. - The placement of 6,170 lineal feet of conduit and the work involved with enlarging Hillview Detention Basin would have similar temporary increases in noise, air pollution contaminants, and traffic congestion, as described for the Selected Plan in paragraph 6.2. As in the Selected Plan, an intensive cultural resources survey of the diversion site and other features would be required, and necessary consultation and mitigation completed before project implementation.

7.0 PUBLIC INVOLVEMENT

7.1 Public Views and Concerns. - Coordination to date has shown strong interest in lessening the existing flood hazard. Concerns associated with riparian removal have been alleviated by elimination of extensive channel improvements and the proposed diversion and conveyance features of the selected plan.

7.2 Public Involvement Program. - A public meeting was held in Salt Lake City, Utah, on 9 August 1977 to discuss flood and related problems in the Jordan River Basin. The consensus of those presenting statements indicated support for investigation of flood and related problems. A Reconnaissance Report, Jordan River Basin Investigation, Utah, December 1978, was reviewed by State and local agencies and the U.S. Fish and Wildlife Service. All supported the interim investigation and expressed interest in being apprised of study progress.

Public workshops were held on 29 and 30 June 1982 to present preliminary findings and alternative plans developed during the investigation. Transcripts taken during public meetings indicate support for flood control improvements. Public officials, local property owners, and fish and wildlife interests expressed support for Detention Basins to minimize channel improvements. They also expressed support for channel improvement measures which would preserve the semi-natural streams and reduce potential impacts on riparian vegetation and the streamside environment. Informal meetings with county officials and neighborhood groups during and following flooding in 1982, 1983, and 1984 continue to reflect strong support for flood control measures and the need to stabilize the streams and restore natural esthetics. A final public meeting was held on 27 May 1987 to discuss the Draft Feasibility Report and Draft EIS which had been circulated for review in May 1987. Public comments and views will continue to be sought in future project stages.

7.3 Required Coordination. - The results of the comments and responses on the Draft EIS have been incorporated into the Final EIS as displayed in Appendix A. The U.S. Fish and Wildlife Service Coordination Act Report (CAR) is included as Appendix C. Copies of this Final EIS are being made available to all concerned public agencies and individuals to obtain comments. The Corps of Engineers South Pacific Division Engineer will issue a public notice announcing completion of the final document and where copies of the final document may be obtained for review and comment. Public and agency comments on the final document are to be submitted to the Board of Engineers For Rivers and Harbors in Fort Belvoir, Virginia. This will be accomplished before the document is filed with the Environmental Protection Agency.

7.4 Statement Recipients. - Notices of availability for copies of this Final EIS were sent to those listed in Appendix F. This includes U.S. Senators and Representatives for the project area, the U.S. Departments of Agriculture (Forest Service and Soil Conservation Service), Commerce (National Marine Fisheries Service), Energy, Health and Human Services, Interior (National Park Service, Bureau of Land Management, Fish and Wildlife Service, Bureau of Reclamation), Housing and Urban Development, Labor, Transportation, Federal Emergency Management Agency, and the Environmental Protection Agency. Notices were sent to the County, State, and Regional agencies in the State of

Utah. Members of the public at large known to be interested are being sent notices as well as organizations which have expressed an interest in the project.

7.5 General Comments and Responses. - The Draft Feasibility Report and the Draft Environmental Impact Statement was made available for public review on 23 April 1987. Notice of availability of the report was published in the Federal Register on 1 May 1987, with the review period remaining open until 15 June 1987.

8.0 ENVIRONMENTAL COMMITMENTS

This is a summary of the environmental commitments that the Corps of Engineers has made in this FEIS as mitigation for impacts resulting from the project.

Description of Commitment	Implementation Timing	Discussed on Page (s)
Riparian mitigation (Mill Creek)	Initiated concurrent with construction	EIS-16 Appendix B-7
Revegetative plantings (Detention Basin)	Following excavation of the detention basin	EIS-16

9.0 REFERENCES

1. Army Corps of Engineers 1968. Transcript of Public Hearing - Review Report on Salt Lake County Streams - Jordan River Basin, Utah. 16 January 1968.

2. Army Corps of Engineers 1974. Little Dell Lake, Salt Lake City Streams. Utah. Final environmental impact statement, Sacramento District, Sacramento, California, 90 pp.

3. Army Corps of Engineers 1977. Transcript of Public Meeting - Jordan River Basin Investigation, Utah. 9 August 1977.

4. Army Corps of Engineers 1979. Jordan River Basin, Environmental Inventory Prepared by EDAW, Inc., for Sacramento District, Sacramento, California.

5. Army Corps of Engineers 1981. Jordan River Interim Investigation Environmental Assessment, Utah. Sacramento District, California.

6. Army Corps of Engineers 1982. Synopsis of Public Workshop onfasvelopment of Flood Control Plans for Mill Creek, Upper Jordan River Interim, Utah. 29 June 1982.

7. Corps of Engineers 1982. Synopsis of Public Workshop on Development of Flood Control Plans for Big and Little Cottonwood Creeks and the Jordan River - Upper Jordan River Interim, Utah. 30 June 1982.

8. Army Corps of Engineers 1985. Upper Jordan River Interim Investigation Utah. Draft Feasibility Report. Sacramento District, California, 118 pp.

9. Berge, Dale L. 1975. Archaeological and Historical Reconnaissance of the Jordan River Project.

10. Janetski, Joel C. 1984. A Cultural Resource Overview of the Jordan River Drainage, North Central Utah. Brigham Young University Museum of Peoples and Cultures.

11. Jensen, Steven F. 1985. Assessment of Salt Lake Valley Tributaries: Recreational Use Impairment and Opportunities. Salt Lake County Public Works, Division of Flood Control and Water Quality.

12. Rollins, Brown and Gunnell, Inc. 1984., Flood Control Feasibility Study for Lower Mill Creek, Provo, Utah.

13. Salt Lake County Council of Government 1978. Water Quality Management Plan, Salt Lake County 208 Water Quality Project.

14. U.S. Geological Survey 1984. Quality and Quantity of Runoff and Atmospheric Deposition in Urban Areas of Salt Lake County, Utah, 1980-1981. Water-Resources Investigating Report 84-4011

10.0 LIST OF PREPARERS

Name	Discipline/ Expertise	Experience	Role in Preparing EIS
Matt Davis	Wildlife/Fisheries Biology	3 years EIS studies Sacramento District Corps of Engineers; 1 year fisheries studies, California Department of Fish and Game	Report Preparation EIS Coordinator
Richard Weaver	Cultural Resources	10 years Federal cultural resource management; 4 years State and private cultural resources experience.	Cultural Resources review, inventory, administration, and coordination.
Fred Kindel	Environmental Planning/Biology	22 years environmental planning, Sacramento District; 8 years private and State employment as a game biologist.	Report review and editing.
Lee McQuivey	Engineering/Water Resources	12 years Bureau of Reclamation (US) Hydrologic Engineer; 17 years Sacramento District, Project Planner and Engineering Division Rep.	Study Manager
Jeffrey W. Groska	Water Resources Planner	2 years Environmental Planner, Sacramento District; 5 years Study Manager, Detroit District; 2 years report preparation, Detroit District; 1 year Hydrographic Survey, Detroit District.	Report review and editing.
Mike Zeckmeister	Environmental Planner/Wildlife Management	1.5 years State Wildlife Technician; 1 year Army wildlife and fisheries biologist trainee.	Impact Evaluation

11.0 INDEX

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FINAL

Environmental Impact Statement

Upper Jordan River, Utah

APPENDIXES

Appendix A - Comments on the Draft EIS and Feasibility Report and Responses

Appendix B - 404(b)(1) Evaluation

Appendix C - Fish and Wildlife Resources:

Letter dated 12 September 1984 from U.S. Fish and Wildlife Service on Endangered Species Act

Planning Aid Letter dated 25 October 1984 from U.S. Fish and Wildlife on Fish and Wildlife Coordination Act

U.S. Fish and Wildlife Service Coordination Act Report

Letter dated 5 June 1986 from U.S. Fish and Wildlife Service on Proposed Enlargement of Hillview Detention Basin

Appendix D - Letter dated 21 November 1984 from U.S. Soil Conservation Service

Appendix E - Letter dated 17 September 1986 from Division of State History on Cultural Resources Survey of the Hillview Detention Basin Area

Appendix F - List of Agencies, Organizations, and Individuals to Whom Copies of the Statement Were Sent

Appendix A

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Comments on the Draft EIS and Feasibility Report and Responses

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COMMENTS ON THE DRAFT EIS AND FEASIBILITY REPORT AND RESPONSES

FEDERAL AGENCIES

Department of the Interior, Office of Environmental Project Review (no date)

1. Comment. The Fish and Wildlife Service has been involved in the field inspection and evaluation of the project and does not believe there will be any significant impacts on fish and wildlife resources in Mill Creek. Likewise, the proposed project will not significantly impact mineral resources.

Response. Noted. No response needed.

Department of Health and Human Services, Public Health Service (June 1, 1987)

1. Comment. We have reviewed this draft EIS for potential adverse human health effects and have no comments to offer at this time.

Response. Noted. No response needed.

Department of Housing and Urban Development, Denver Regional Office, Region VIII (June 10, 1987)

1. Comment. Your DEIS has been reviewed with consideration for the areas of responsibility assigned to the Department of Housing and Urban Development. This review considered the proposal's impacts on housing and community development. The proposed action will provide flood control in an urbanizing area; therefore, we find this document adequate for our purpose.

Response. Noted. No response needed.

Department of Commerce, National Oceanic and Atmospheric Administration (June 11, 1987)

1. Comment. Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, Charting and Geodetic Services (C&GS) requires not less than 90 days notification in advance of such activity in order to plan for their relocation. C&GS recommends that funding for this project include the cost of any relocation required for C&GS monuments.

Response. Coordination will be conducted with the Director, Charting and Geodetic Services, to avoid disturbing or destroying survey control monuments.

Environmental Protection Agency, Region VIII, (June 11, 1987)

1. Comment. Based on the procedures EPA uses to evaluate the adequacy and impacts of a draft EIS, EPA concludes the Upper Jordan River draft EIS will be listed in the Federal Register in the category LO (Lack of Objections).

Our review has not identified potential environmental impacts requiring substantive changes to the preferred alternative. Please provide this office copies of the final EIS and Record of Decision when they become available.

Response. Noted. No response needed.

Department of Agriculture, Soil Conservation Service, (June 12, 1987)

1. Comment. We have reviewed the Draft Feasibility Report and Draft Environmental Impact Statement for the Upper Jordan River Interim Investigation, Utah. We have no comments.

Response. Noted. No response needed.

STATE AGENCIES

Department of Natural Resources, Wildlife Resources Division, (June 8, 1987)

1. Comment. Page 26, para. 1 - The division does not annually stock German brown trout in Little Cottonwood Creek as stated.

Response. Noted. Text has been corrected.

2. Comment. Page 26, para. 2 - The Jordan River from the confluence with Little Cottonwood Creek downstream to 2100 South Street is a significantly better fishery than stated, probably as a result of the past few high water years. White bass, walleye, sunfish, and channel catfish have moved into this section of the stream.

Response. Noted. The feasibility report has been revised to show an improvement in the fishery along this reach of the Jordan River.

3. Comment. Page 28, para. 1 - The last sentence of the paragraph -- we assume it refers to a bald eagle winter roost site. However, we do not know of a roost site at this location. There is a bald eagle roost site located northwest of Salt Lake City. There are several golden eagle nest sites on Lake Mountain west of Utah Lake and in the Wasatch Mountains east of Salt Lake Valley.

Response. The feasibility report has been revised to reflect this information.

4. Comment. Page 126, para. 3 - The section of Mill Creek where the diversion structure is proposed is a Class 6 fishery. As such, we anticipate few, if any, serious impacts to the fishery resource. However, as a means for possible future enhancement for fisheries, the diversion structure could be designed to include provision for fish movement through the structure if it is not already included.

Response. Given the Class 6 fishery (periodically dewatered) classification for this reach of Mill Creek, the existing fishery was not judged to be of significant value to justify the incorporation of costly structural measures into the diversion structure to allow fish migration. However, this subject will be reexamined in future detailed design studies if the project is authorized and funded for construction by Congress.

5. Comment. Page EIS-19, para. 1 - There are no longnose darter present in Mill Creek.

Response. Noted. The EIS has been corrected to reflect this information.

6. Comment. Page EIS-22, para. 3 - Same comment as the one made for page 126, paragraph 2.

Response. See response 4.

Department of Community and Economic Development, Division of State History (May 5, 1987)

1. Comment. Page 7, the Utah Division of State History is not listed as a state agency participating in this study. Our office is assuming that we are included as part of the State Planning Coordinator's Office.

Response. Noted. We apologize for the oversight. The feasibility report has been revised to reflect your participation.

2. Comment. Page 34, it states that there are no changes expected in archeological values, but that periodic flooding could damage or destroy existing historic structures located on the flood zones. We believe that is correct, and that some effort should be made to identify as many of the existing cultural resources as possible.

Response. Concur. The reconnaissance work reported in the draft feasibility report and EIS was considered a preliminary phase of fieldwork designed to locate evidence of existing cultural resources properties. An intensive level of historical and archeological research will be undertaken to locate additional properties if project construction is authorized and funded by Congress.

3. Comment. Page 74, we believe it is important that consideration be given to evaluation and preservation of cultural resources.

Response. Noted. No response needed.

4. Comment. The Preservation Office has reviewed the surveys that have been done for the project area, with very few sites being located, and have no additional information to add to the material provided in the EIS.

Response. Noted. No response needed.

Office of Planning and Budget, (June 10, 1987)

1. Comment. The Resource Development Coordinating Committee of the State of Utah has reviewed this proposed action, and no comments are indicated.

Response. Noted. No response needed.

CITY/COUNTY AGENCIES

Salt Lake County Public Works Department, Flood Control and Highway Divisions (28 May 1987)

1. Comments. We would like to offer supplemental comments concerning Table 2. Flow values and dates are in error or have been updated.

Response. Tables 2 and 3 have been modified to comply with the information provided.

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
DENVER FEDERAL CENTER, BUILDING 67, ROOM 488
P.O. BOX 25007
DENVER, COLORADO 80225-0007

ER 87/521

Wayne J. Scholl
Colonel, Corps of Engineers
District Engineer
Sacramento District Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Dear Colonel Scholl:

We have reviewed the Draft Environmental Statement and Draft Feasibility Report for the Upper Jordan River Interim Investigation, Utah, and offer the following comments:

The Fish and Wildlife Service has been involved in the field inspection and evaluation of the project and does not believe there will be any significant impacts on fish and wildlife resources in Mill Creek. Likewise, the proposed project will not significantly impact mineral resources.

Sincerely,

Robert F. Stewart

Robert F. Stewart
Regional Environmental Officer

DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service

Centers for Disease Control
Atlanta GA 30333

June 1, 1987

Colonel Wayne J. Scholl
District Engineer
Sacramento District,
  Corps of Engineers
Attention: Planning Division
650 Capitol Mall
Sacramento, California 95814-4794

Dear Colonel Scholl:

Thank you for sending us the Draft Feasibility Report and the Draft Environmental Impact Statement (EIS) for the Upper Jordan River Interim Investigation, Utah. We are responding on behalf of the U.S. Public Health Service.

We have reviewed this draft EIS for potential adverse human health effects and have no comments to offer at this time.

We appreciate the opportunity to review this EIS. Please send us a copy of the final document when it becomes available.

Sincerely yours,

Vernon N. Houk, M.D.
Assistant Surgeon General
Director
Center for Environmental Health

U.S. Department of Housing and Urban Development
Denver Regional Office, Region VIII
Executive Tower
1405 Curtis Street
Denver, Colorado 80202-2349

June 10, 1987

Mr. Paul Keil
Planning Division
Sacramento District Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Mr. Keil:

This is in response to your letter of April 23, 1987, requesting comments on the Draft Environmental Impact Statement (DEIS) for the Upper Jordan River Interim Investigation, Utah.

Your DEIS has been reviewed with consideration for the areas of responsibility assigned to the Department of Housing and Urban Development. This review considered the proposal's impacts on housing and community development. The proposed action will provide flood control in an urbanizing area; therefore, we find this document adequate for our purpose.

If we may be of further assistance, please contact Mr. Howard Kutzer, Regional Environmental Officer, at FTS 564-3102.

Sincerely,

Robert J. Matuschek

Robert J. Matuschek
Director
Office of Community
Planning and Development

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

OFFICE OF THE COMPTROLLER

June 11, 1987

Department of the Army
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814-4794

Attn: Planning Division

Dear Sir:

This is in reference to your Draft Environmental Impact Statement on the Upper Jordan River Interim Investigation, Utah. Enclosed are comments from the National Oceanic and Atmospheric Administration.

We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

DC

David Cottingham
Ecology and Conservation Division

Enclosure

cc: Bohne

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF CHARTING AND GEODETIC SERVICES
ROCKVILLE, MARYLAND 20852

N/CGx11:JVD

JUN 8 19

MEMORANDUM FOR: David Cottingham
Ecology and Conservation Division

FROM: Rear Admiral Wesley V. Hull, NOAA
Director, Charting and Geodetic Services

SUBJECT: DEIS 8704.08-Upper Jordan River Interim
Investigation, Utah

The subject statement has been reviewed within the areas of Charting and Geodetic Services' (C&GS) responsibility and expertise, and in terms of the impact of the proposed action on C&GS activities and projects.

Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, C&GS requires not less than 90 days' notification in advance of such activity in order to plan for their relocation. C&GS recommends that funding for this project includes the cost of any relocation required for C&GS monuments. For further information about these monuments, please contact Mr. John Spencer, Chief, National Geodetic Information Branch (N/CG17), or Cdr. Melvyn C. Grunthal, Chief, Operations Branch (N/CG16), at 6001 Executive Boulevard, Rockville, Maryland 20852.

Attachment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET—SUITE 500
DENVER, COLORADO 80202-2405

JUN 1 1 1987

Ref: 8PM-EP

Colonel Wayne Scholl
District Engineer
U.S. Army Engineer District
650 Capitol Mall
Sacramento, California 95814

Dear Colonel Scholl:

In accordance with our responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act, the Region VIII Office of the Environmental Protection Agency has reviewed the draft Environmental Impact Statement on the Upper Jordan River, Utah.

Based on the procedures EPA uses to evaluate the adequacy and impacts of a draft EIS, EPA concludes the Upper Jordan River draft EIS will be listed in the Federal Register in the catagory LO (Lack of Objections). Our review has not identified potential environmental impacts requiring substantive changes to the preferred alternative. Please provide this office copies of the final EIS and Record of Decision when they become available.

Sincerely,

Robert R. DeSpain

Robert R. DeSpain, Chief
Environmental Policy Branch
Policy and Management Division

cc: William Dickerson, OFA Headquarters

United States
Department of
Agriculture

Soil
Conservation
Service

P. O. Box 11350
Salt Lake City, UT 84117

June 12, 1987

Wayne J. Scholl, Colonel
District Engineer
Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814-4794

Attention: Planning Division

Dear Colonel Scholl:

We have reviewed the Draft Feasibility Report and Draft Environmental Impact Statement for the Upper Jordan River Interim Investigation, Utah. We have no comments.

We appreciate the opportunity to review and comment.

Sincerely,

John L. [illegible], acting

FRANCIS T. HOLT
State Conservationist

The Soil Conservation Service
is an agency of the
United States Department of Agriculture

STATE OF UTAH
NATURAL RESOURCES
Wildlife Resources

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
William H. Geer, Division Director

1596 West North Temple · Salt Lake City, UT 84116-3154 · 801-533-9333

June 8, 1987

Mr. Paul Keil
U.S. Army Corps of Engineers
8402 Federal Building
123 South State
Salt Lake City, UT 84138

Dear Mr. Keil:

We have completed our review of the draft Upper Jordan River Interim Investigation report and have the following comments.

Page 26, para. 1 - The division does not annually stock German brown trout in Little Cottonwood Creek as stated.

Page 26, para. 2 - The Jordan River from the confluence with Little Cottonwood Creek downstream to 2100 South Street is a significantly better fishery than stated, probably as a result of the past few high water years. White bass, walleye, sunfish and channel catfish have moved into this section of the stream.

Page 28, para. 1 - The last sentence of the paragraph--we assume it refers to a bald eagle winter roost site. However, we do not know of a roost site at this location. There is a bald eagle roost site located northwest of Salt Lake City. There are several golden eagle nest sites on Lake Mountain west of Utah Lake and in the Wasatch Mountains east of Salt Lake Valley.

Page 126, para. 2 - The section of Mill Creek where the diversion structure is proposed is a Class 6 fishery. As such, we anticipate few if any serious impacts to the fishery resource. However, as a means for possible future enhancement for fisheries, the diversion structure could be designed to include provision for fish movement through the structure if it is not already included.

Page EIS-19, para. 1 - There are no longnose darter present in Mill Creek.

Page EIS-22, para. 3 - Same comment as the one made for page 126, paragraph 2.

We appreciate the opportunity to comment and review.

Sincerely,

William H. Geer
Director

an equal opportunity employer

NORMAN H. BANGERTER
GOVERNOR

STATE OF UTAH
DEPARTMENT OF COMMUNITY AND
ECONOMIC DEVELOPMENT

Division of
State History
(UTAH STATE HISTORICAL SOCIETY)

MAX J. EVANS, DIRECTOR
300 RIO GRANDE
SALT LAKE CITY, UTAH 84101 1182
TELEPHONE 801/533-5755

May 5, 1987

Wayne J. Scholl
Colonel, Corps of Engineers
District Engineer
Attn: Planning Division
Colorado/Great Basin Branch
Sacramento District Corps of Engineers
650 Capitol Mall
Sacramento, California 95184-4794

RE: Upper Jordan River Draft Environmental Impact Statement

In Reply Please Refer to Case No. J868

Dear Colonel Scholl:

The Utah Preservation Office has received for consideration the above referenced document. As requested, our office has the following comments for consideration by the Corps.

1. Page 7, the Utah Division of State History is not listed as a state agency participating in this study. Our office is assuming that we are included as part of the State Planning Coordinator's Office.

2. Page 34, it states that there are no changes expected in archeological values, but that periodic flooding could damage or destroy existing historic structures located on the flood zones. We believe that is correct, and that some effort should be made to identify as many of the existing cultural resources as possible.

3. Page 74, we believe it is important that consideration be given to evaluating and preserving cultural resources.

4. The Preservation Office has reviewed the surveys that have been done for the project area, with very few sites being located, and have no additional information to add to the material provided in the EIS.

If we can be of any further assistance, please let us know. The above is provided on request for assistance as outlined by 36 CFR 800 or Utah Code, Title 63-18-37. If you have questions or need additional assistance, please contact Jim Dykman at (801) 533-7039.

Sincerely,

Max J. Evans
Director and
State Historic Preservation Officer

1896

116 State Capitol Building
Salt Lake City, UT 84114
Telephone 801-533-5245

office of planning and budget

Norman H. Bangerter, Governor Dale C. Hatch, C.P.A., J.D., Director Michael E. Christensen, Ph.D., Deputy Director

June 10, 1987

U.S. Army Corps of Engineers
Sacramento District
Attention: Planning Division
650 Capitol Mall
Sacramento, California 95814-4794

SUBJECT: Draft Feasibility Report and Draft EIS - Upper Jordan River Interim Investigation
State Application Identifier #UT870424-010

To Whom It May Concern:

The Resource Development Coordinating Committee of the State of Utah has reviewed this proposed action and no comments are indicated.

Thank you for the opportunity of reviewing this document. Please address any other questions regarding this correspondence to Carolyn Wright (801) 533-4971.

Sincerely,

Michael E. Christensen

Michael E. Christensen
Deputy Director

MEC/jw

cc: Paul Keil
U.S. Army Corps of Engineers, SLC

Salt Lake County Public Works
Flood Control and Highway Divisions

SALT LAKE COUNTY PUBLIC WORKS DEPARTMENT
FLOOD CONTROL & HIGHWAY DIVISIONS
2001 S State St #N3300
Salt Lake City, UT 84190-4600
Phone 468-2711

COMMISSIONER
DAVE WATSON
DIRECTOR OF PUBLIC WORKS
JOHN D. HISKEY
DIVISION DIRECTOR
R.T. HOLZWORTH, P.E.

Planning Manager
David R. Lovell, P.E.

Engineering Manager
Terry E. Baker, P.E., L.S.

Transportation
Engineer
Tosh Kano, P.E.

Field Services Manager
Neil D. Stack, P.E.

May 28, 1987

U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814-4794

Attn: Planning Division

SUBJECT: Upper Jordan River Interim Investigation, Utah: Draft Feasibility Report and Draft Environmental Impact Statement

We would like to offer the following supplemental comments concerning Table 2 (pg 21) contained in the above report.

It appears that some of the flow values and dates are in error or have been updated since the table was drafted. Listed on the attached table are the values we believe to be correct or new values (our changes underlined). This information comes from the U.S. Geological Survey or from our own field stations and is published by us. Also, it is unknown whether the data shown in the table are on a calander or water year basis. This does not make much difference except when the peak occurs at a time different than snowmelt runoff.

It should be noted that the values given for Big and Little Cottonwood Creeks are for the flow through flumes at the canyon mouths. Due to the location of hydroelectric and water treatment plants also at the canyon mouths and their operational procedures, water is often bypassed around the flumes and therefore not measured. Because of the turbidity of snowmelt and storm runoff, high flows most often are not bypassed. It is very difficult to accurately maintain records of actual instream flows at the canyon mouths. We maintain streamflow stations below the canyon mouths to help recitfy this situation.

Pending further review of this document, additional comments may be forthcoming.

Sincerely,

Terry Way

Terry G. Way, P.E.
Flood Control Engineer

attachment (1)

TGW/tgw

file # 0009.34
274/40

TABLE 2.

HISTORIC STREAMFLOW DATA

(as revised tgw 5/27/87)

Stream Gage	Average Annual Runoff (1000 af)	Maximum Daily Discharge (cfs)	Maximum Daily Discharge Date	Peak Discharge (cfs)	Peak Discharge Date (if different)
Jordan River at 2100 S. (includes Surplus Canal)	286	1756	6/7/52	-	
		1564	9/18/78	2200	
		2482	9/26/82	2540	
		3350	6/12/83	-	
		4510	6/01/84	4800	
		2634	5/11/85	-	
Jordan River at Narrows (includes canal diversions)	266	1410	6/10/52	-	
		2150	6/23/83	-	
		3030	6/20/84	3100	
		1580	4/18/85	-	
Little Cottonwood Creek at Canyon Mouth	48	762	6/11/21	-	
		-	-	890*	9/26/82
		507*	7/9/83	819	
		635	6/1/84	874	5/31/84
		287	6/8/85	416	
Big Cottonwood Creek at Canyon Mouth	53	848	6/8/12	-	
		-	-	980*	9/26/82
		668	5/31/83	849	5/30/83
		765	5/31/84	979	6/1/84
		308	5/10/85	337	
Mill Creek at Canyon Mouth	11	152	5/20/49	-	
		-	9/26/82	43	
		172	5/30/83	241	
		134	6/1/84	150	
		69	5/10/85	88	

- = Data unavailable
* = Data approximate

file # 0009.34
274/41

Appendix B

Section 404 (b) (1) Evaluation
Upper Jordan River, Utah

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- b. General Description
- c. Authorization
- d. General Description of Fill Material
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- f. Description of Disposal Method

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- b. Water Circulation, Fluctuation, and Salinity Determinations
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- d. Contaminants Determinations
- e. Aquatic Ecosystem and Organism Determinations
- f. Proposed Disposal Site Determinations
- g. Determination of Cumulative Effects on the Aquatic Ecosystem
- h. Determination of Secondary Effects on the Aquatic Ecosystem

III. Finding of Compliance

Upper Jordan River, Utah
Flood Control Project

Introduction. - Section 404 of the Clean Water Act (33 USC 1344) requires an evaluation of water quality considerations associated with the placement of dredged or fill material into the waters of the United States. The requirements under Section 404(r) of the Act are: (1) to obtain state water quality certification, or (2) to obtain an exemption from Congress based on information on the effects of the discharge being described in the Environmental Impact Statement (EIS) and to be submitted to Congress prior to project authorization or appropriation of construction funds.

I. Project Description.

a. Location. - The Jordan River Basin, located in central Utah, encompasses a 3,800 square mile drainage basin. The proposed project is located on Mill Creek, a major tributary to the Jordan River. Mill Creek originates in the Wasatch Mountains in the south part of Salt Lake City, and traverses suburban areas and valley lands en route to the Jordan River.

b. General Description. - The proposed upper Jordan River project would involve diversion of floodflow up to 750 cfs into a conduit for conveyance to the Hillview Detention Basin. The feasibility report (pages 103-129) contains a detailed description of the selected plan. The following features are under evaluation:

(1) A diversion dam, located about 200 feet above Highland Drive. Fill material would be placed as foundation for the diversion structure. The diversion dam would incorporate a debris trap to prevent the diversion structure from becoming clogged.

(2) A 7,440-foot pipeline connecting Mill Creek with the Hillview Detention Basin.

(3) Enlarging Hillview Detention Basin by 74 acre-feet. No discharge of dredged or fill material would take place. Material excavated would be placed in upland areas above ordinary high water. Therefore, no water quality effects are associated with this feature.

c. Authorization. - The basic authorization for this investigation is contained in Section 6 of the Flood Control Act of 1938 which authorized studies of flood problems on streams draining into the Great Salt Lake and the Great Basin of Utah and Nevada. In October 1960 the Chief of Engineers authorized investigation of the Jordan River Basin, and in March 1979 South Pacific Division, Corps of Engineers approved interim investigation of the Upper Jordan River area.

d. General Description of Fill Material.

(1) General Characteristics of Material. - Project implementation would involve excavation of material for the debris basin and diversion structure and the placement of riprap, concrete, and earthen backfill at the diversion site. These materials would be free of contaminants and in compliance with applicable water quality criteria.

(2) Quantity of Material. - Approximately 1,630 cubic yards would be excavated. Approximately 400 cubic yards of earthen backfill, 850 cubic yards of concrete, and 30 cubic yards of riprap, are estimated for placement.

(3) Source of Material. - Sources of material are summarized below:

- Backfill from the excavated material at site.

- Sand and concrete from commercial sources.

- Riprap from commercial sources.

e. Description of the proposed discharge sites.

(1) Location. - The discharge site for the diversion structure is located on the banks and within the channel of Mill Creek and covers approximately 180 feet in length and 57 feet in width.

(2) Type of Sites. - The discharge site is an aquatic habitat with streamside vegetation and is classified as a Riverine, Intermittent, streambed habitat under the Fish and Wildlife Service National Wetland Inventory (NWI).

(3) Timing and Duration of Discharge. - The discharge would probably begin in July and end in October with no construction during the winter season. The estimated total construction time would be approximately four months.

f. Description of Disposal Method. - The fill would be discharged by front end loaders and dump trucks.

II. Factual Determinations.

a. Physical Substrate Determinations. - (bottom material of waterway or wetland)

(1) Fill Material. - The material to be placed at the diversion site will consist of grouted rock and concrete. The disposal area for materials excavated from the creek will be contained in upland disposal sites to be selected by the project sponsor. Minor amounts of fill would be placed in association with road and utility relocations required by the alternatives.

(2) Physical Effects Due to Changes in Bottom Elevation or Contours. - Detrimental effects such as erosion or lateral displacement will be reduced by diversion of floodflows. Banks will be sloped and areas subject to erosion would be protected.

(3) Fill Material Movement. - The nature of the material would preclude movement within the watercourse.

(4) Physical Effects on Benthos. - Placement of fill material will cover approximately 0.20 acres of benthic habitat and 0.10 acre of streamside vegetation. The benthic communities covered during construction would temporarily reduce species diversity abundance. Recolonization would be rapid since the nature of the sediment and hydrology of the affected area

would essentially remain unchanged. However, recolonization would not occur where the diversion structure is located. This effect would be somewhat reduced by the establishment of sessile species on the hard substrate.

(5) Other Impacts. - No other significant adverse impacts to the physical substrate were identified.

(6) Action Taken to Minimize Impacts. - Flow diversion structures, silt screens, and timing of construction during low flows would minimize the impacts of turbidity and suspended solids.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water

(a) Salinity. - Not applicable.

(b) Water Chemistry. - The discharge would not result in an appreciable chemical change because of the inert nature of the fill material.

(c) Clarity. - Minor and localized reduction would occur during construction.

(d) Color. - Slightly modified during construction.

(e) Odor. - No significant adverse effect.

(f) Taste. - No significant adverse effect.

(g) Dissolved Gas Levels. - Localized modification to dissolved gas levels would occur during construction.

(h) Nutrient Levels. - The nature of the fill material would preclude any significant change in the nutrient cycle or food supply.

(i) Eutrophication. - Eutrophication modifications would be negligible.

(j) Others as Appropriate. No other significant adverse impacts to water parameters are anticipated.

(2) Current Patterns and Circulation.

(a) Current Patterns and Fluctuations. - During construction of the diversion structure, flows would be bypassed around the diversion site to avoid dewatering the stream. Water patterns and fluctuations during high water flow would be significantly altered in order to reduce flooding within the basin. The diversion dam is designed to maintain Mill Creek flow up to 200 cfs to the channel and to divert up to 750 cfs into the pipeline for conveyance to the Hillview Detention Basin. The Detention Basin would have 74 acre-feet of capacity dedicated to Mill Creek diversions. The Detention Basin would be periodically flooded during flood events and drained via conduit to Big Cottonwood Creek.

(b) Velocity. - The fill and the constructed diversion structure would significantly alter the velocity of flow in the vicinity of the diversion.

(c) Stratification. - No impact.

(d) Hydrological Regime. - The dewatering that currently takes place in the winter will continue. During high flow periods water would be diverted as described in Paragraph II. b.(2)(a).

(3) Normal Water Level Fluctuations. - Water flows higher than 200 cfs may be diverted producing lower high water levels resulting in a decreased range in water fluctuation downstream from the diversion structure. These conditions would occur infrequently during rainstorm events greater than the 100-year level. During other periods, normal water levels should be unchanged.

(4) Salinity. - Not applicable.

c. Suspended Particulates/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposed Site. - Turbidity increases caused by the project will be construction related and short-term. No long-term increases in suspended load would result from the project operation. Suspended particulate loads and turbidity could be reduced by minimizing sheetflow across unstabilized substrates. The debris basin would lower long-term turbidity and suspended particulate levels downstream of the diversion structure. Turbidity controls would be implemented as discussed in Paragraph II a.(6).

(2) Effects (Degree and Duration) on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. - Localized short-term reductions in light penetration would occur during construction.

(b) Dissolved Oxygen. - Localized short-term reduction in dissolved oxygen would occur during construction.

(c) Toxic Metals and Organics. - Toxic metals or organics are not known to exist in concentrations sufficient enough to adversely affect the physical properties of the water column.

(d) Pathogens. - The discharge would have no effect on pathogenic levels.

(e) Esthetics. - The effects of the discharge may be viewed as esthetically displeasing by some observers.

(3) Effects on Biota.

(a) Primary Production, Photosyntheses. - Localized reductions would occur in the project area during construction.

(b) Suspension Filter Feeders. - The localized increase in turbidity and suspended particulates during construction would have a short-term adverse impact on filter feeders.

(c) Sight Feeders. - The localized increase in turbidity and suspended particulates during construction would have a short-term adverse impact on sight feeders.

(4) Actions Taken to Minimize Impacts. - Refer to Paragraph II a.(6).

d. Contaminant Determinations. - The fill material does not possess by nature an affinity for contaminants. Thus, the possibility of introducing, relocating, or increasing contaminants is remote.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on the Diversity of Plants and Animal Species. - Diversion and conveyance measures would have little effect on riparian vegetation and wetlands. The loss of approximately 0.3 acres of riparian habitat at the diversion site would be replaced by planting streambanks. Periodic flooding and draining of the Detention Basin will displace upland vegetation and facilitate invasion of water tolerant species. The change in vegetation produced by fluctuating water levels will lead to a change in wildlife species during times of the year when the basin is not flooded. The project will not jeopardize the habitat of any threatened or endangered species.

(2) Effects on Animal Movements. - The discharge itself will not significantly affect the movement of aquatic organisms.

(3) Effects on Benthic, Shellfish, and the Fishery. - The discharge will not significantly affect benthic life and the fishery dependent upon it. No fish species in the study area are Federally listed as endangered or threatened.

(4) Effects on Special Aquatic Sites. -

(a) Wetlands. - Areas contiguous to Mill Creek are highly urbanized and the proposed work would not occur in any identified wetlands.

(b) Vegetated Shallows. - The proposed work will not have significant adverse impact on vegetated shallows.

(c) Riffle and Pool. - The proposed work will not affect riffle and pool complexes.

(5) Measures to Avoid Significant Impacts on the Aquatic Ecosystem. - The work will be designed to avoid disturbances to the aquatic resources in the creek including the riparian habitat adjacent to the creek. The proposed work will not violate water quality or effluent standards.

f. Proposed Disposal Site.

(1) Effects on Municipal and Private Water Supply. - The disposal of material excavated from the diversion site will be placed in confined upland disposal sites. No effluent is anticipated to return to the stream or adjacent wetlands.

(2) Effects on Esthetic, Recreation, or Economic Values. - The discharge will not significantly degrade esthetic, recreation, or economic values. The proposed discharge sites will be selected to avoid damaging environmentally sensitive areas.

(3) Measures to Avoid Significant Effects as a Result of Disposal (reseeding, revegetation, method of disposal, etc.) - Dust and erosion control measures will be included in plans and specifications.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. - The cumulative effect of the disposal will not result in impairment of the water resources or aquatic ecosystem.

h. Determination of Secondary Effects on the Aquatic Ecosystem. -

(1) Effects on Water Fluctuation, Elevations or Modification of Streamflow. - Streamflow would be limited to 200 cfs.

(2) Effects on Surface Runoff or Leaching of Undesirable Wastes. - The discharge will not increase surface runoff or leaching of wastes associated with residential or commercial development. It is anticipated that because overbank flows would be greatly reduced, the leaching and runoff of undesirable wastes would likewise be reduced.

(3) Measures to Avoid or Reduce Secondary Effects on the Aquatic Ecosystem. - (minimum flow releases, treatment of runoff, etc.) - No measures are needed to reduce secondary effects on the aquatic ecosystem.

III. Finding of Compliance for the Upper Jordan River Interim Investigation.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. Federal action for flood control is limited to Mill Creek. Nonstructural and structural measures were investigated in meeting planning objectives for flood control along Mill Creek. Levees above the ordinary high water mark were considered as alternate disposal areas but were determined infeasible because of lack of available vacant land space adjacent to Mill Creek for levee construction and right-of-way. Upstream reservoirs were eliminated because of social, economic, and environmental considerations. Parkway concepts were eliminated because of economic considerations. The EIS considered the following alternatives in detail: No Action, channel improve- ment, and two diversion/conveyance plans; diversion at 1300 East Avenue; and diversion above Highland Drive.

c. The discharge will not violate any applicable State Water Quality Standards or the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The proposed discharge of the Selected Plan would not affect any Federally listed or proposed threatened or endangered species since no such species are known to occur within the area of influence of the project.

e. The proposed disposal of dredged material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, esthetic and economic values will not occur.

f. Appropriate steps to minimize potential adverse impacts of the discharge include flow diversion structures, silt screens, timing of construction during low flow, and habitat mitigation.

g. On the basis of the guidelines, the proposed disposal sites for the discharge of dredged material are specified as complying with the inclusion of appropriate and practical measures to minimize pollution or adverse effects to the aquatic ecosystem.

h. Statement of Compliance. - On the basis of the guideline, the proposed disposal sites for the discharge of fill material is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical measures to minimize pollution or adverse effects to the affected aquatic ecosystems.

Appendix C

Fish and Wildlife Resources

Page

- Letter dated 12 September 1984 from U.S. Fish and Wildlife Service on Endangered Species Act 193
- Planning Aid Letter dated 25 October 1984 from U.S. Fish and Wildlife on Fish and Wildlife Coordination Act 194
- U.S. Fish and Wildlife Service Coordination Act Report 199
- Letter dated 5 June 1986 from U.S. Fish and Wildlife Service on Proposed Enlargement of Hillview Detention Basin 203

United States Department of the Interior
FISH AND WILDLIFE SERVICE
ENDANGERED SPECIES OFFICE
1406 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138-1197

IN REPLY REFER TO:

September 12, 1984

Mr. George C. Weddell
Chief, Engineering Division
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Mr. Weddell:

This responds to your letter dated September 6, 1984, describing your proposed Jordan River, Utah project area and requesting information on threatened and endangered species. We have determined that no Federally listed or proposed threatened or endangered species are known to occur within the area of influence of this project.

Your interest in conserving endangered species is appreciated.

Sincerely,

Fred L. Bolwahnn
Field Supervisor

United States Department of the Interior
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
1311 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138-1197

IN REPLY REFER TO: (ES) October 25, 1984

Albert E. McCollam, Jr.
Lieutenant Colonel, Corps of Engineers
Department of the Army
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

ATTN: Robert Verkade

RE: SPKED-W, Upper Jordan River Interim Investigation, Salt Lake City, Utah

Dear Colonel McCollam:

As per your request of September 6, 1984, we are providing the following information as a planning aid letter for your consideration for inclusion in the proposed draft environmental impact statement for the Upper Jordan River Interim Investigation, Salt Lake County, Utah. This is an unreviewed draft subject to revision by Utah Division of Wildlife Resources and our Regional Office in Denver, Colorado. Therefore, this letter does not constitute our formal report as required under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended, 16 U.S.C. 661 et. seq.).

It is the Fish and Wildlife Service's (FWS) understanding the final array of alternatives being studied in detail are No Action and two plans for improving the flood carrying capacity of Mill Creek, a tributary of the Jordan River. We believe the information provided in our previous correspondence of July 20, 1979 and September 25, 1981 is still applicable even though the proposed project is smaller in scope. The project, as presently proposed, no longer includes Big and Little Cottonwood Creeks, tributary streams of the Jordan River. Therefore, our comments address only those two sections of Mill Creek that are being considered for flood carrying capacity improvement and the No Action Alternative.

EXISTING FISH AND WILDLIFE RESOURCES

Fish

Mill Creek. Mill Creek is 18.4 miles long with 10.7 miles on privately owned land and 7.7 miles of U.S. Forest Service (FS) land. For fishery management purposes, the Utah Division of Wildlife Resources (UDWR) has divided Mill Creek into four sections for description and classification. The project alternatives being considered for Mill Creek are all contained within sections one and the lower segment of section two.

Section one extends from the mouth of Mill Creek at the Jordan River upstream to Scott Avenue. This reach flows through urban Salt Lake City and is bordered primarily by grasses and ornamental plants. Bank stabilization and shading are poor; however, streamflow, while somewhat variable, is adequate for sustaining a fishery. The stream bottom is heavily silted limiting aquatic invertebrate production, and habitat is further degraded by an abundance of trash in the channel. Resident fish in this reach of Mill Creek include rainbow trout (*Salmo gairdneri*), brown trout (*Salmo trutta*), walleye (*Stizostedion vitreum*), carp (*Cyprinus carpio*), longnose dace (*Rhinichthys cateratae*), Utah sucker (*Catistinys ardens*) and mountain sucker (*Catostomus platyrhynchus*). Angling pressure for the limited trout populations comes primarily from local children. The UDWR has designated this stretch of Mill Creek as a Class IV (limited fishery resource) fishery.

Section two extends from Scott Avenue upstream to 2300 East; however, project related activities will end near Highland Drive. This reach also flows through privately owned residential property and is bordered primarily by grasses and ornamental plants. Diversions in this section of Mill Creek cause complete dewatering during winter months and thus, render this reach of the stream valueless as a fishery. Because of extensive dewatering, the UDWR has designated this reach as a Class VI (periodically dewatered) fishery; but believes that with a guaranteed minimum flow, a valuable trout fishery could be established.

WILDLIFE

Terrestrial wildlife use is similar throughout the project area and is dominated by a large variety and number of passerine birds. A few species of small mammals, amphibians, and reptiles are also represented. There are no known threatened or endangered species of flora or fauna along these two sections of Mill creek.

FUTURE FISH AND WILDLIFE RESOURCES

WITHOUT-THE-PROJECT

In response to the 208 Water Quality Management Plan which provides for upgrading effluent from sewage treatment plants, water quality in the study area is expected to continue to improve. However, structural flood control facilities such as piecemeal channel improvements and discharge from storm drains are expected to have an adverse impact on the water quality. These changes in water quality are expected to have a minor impact on fishery resources in the project area. Furthermore, unless provisions for the maintenance of minimum streamflows are established, diversions will continue to limit the fishery potential in Mill Creek.

Terrestrial wildlife species will continue to be displaced as urban growth continues and human activity increases. As more habitat is lost to urbanization, the narrow zone of riparian vegetation will become even more valuable for the various species of wildlife in the project area.

WITH-THE-PROJECT

FISH

Alternative

NO ACTION. Fishery resources under the No Action Alternative are expected to be the same as that mentioned above for future conditions without the project.

Channel and Diversion at 1300 East. Channelization between 900 West and State Street will at least temporarily or possibly permanently eliminate the existing fishery habitat in this stretch of the stream. Construction of a concrete or grouted rock channel from 1300 East to Highland Drive would cause a permanent loss of habitat, and fishery and aquatic resources in this section of Mill Creek. However, fishery values in this section of creek are limited due to dewatering.

Also, the draining of Mill Creek between 1300 East and Highland Drive prior to construction of the diversion dam, conduit and grouted rock channel will be detrimental to fish and other aquatic species that may enter and be using this stretch of the creek. Periodic filling and draining of the Hillview Detention Basin during spring runoff could cause stranding of these fish which may enter the collector systems and basin during high flows.

Channel and Diversion at Highland Drive

It is expected that impacts would be similar to those that would occur in the Channel and Diversion at 1300 East Alternative. Channelization between 900 West and State Street will temporarily or possibly permanently eliminate the existing fishery habitat in this stretch of stream. Though impacts would be reduced due to the elimination of the concrete or grouted rock channel, the periodic filling and draining of the Hillview Detention Basin may still cause the stranding of fish during the operation of this system. But as noted previously, fishery values are limited due to dewatering.

WILDLIFE

Terrestrial wildlife use is similar within the project area. Construction activities associated with channel improvement and bridge modification work will result in a permanent loss of the limited riparian vegetation. Destruction of this vegetation will displace those resident and seasonal passerine birds and small mammals dependent upon riparian habitat.

Periodic flooding and draining of the detention basin under consideration will result in a change of vegetation from that now present. Fluctuating water levels will displace upland vegetation and facilitate invasion of water tolerant species. Changes in vegetation species in the detention basin will lead to changes in the wildlife species utilizing the basin during times of the year when not flooded. Periodic flooding will destroy some small mammal populations in the basin and reduce habitat for small birds and other mobile species.

DISCUSSIONS

Care should be taken to avoid construction work in section one (from the confluence of Mill Creek and the Jordan River to Scott Avenue) of the stream channel during important spawning times. Such activity in this section should be avoided during early to late spring when rainbow trout and walleye spawn and from November through December when brown trout spawn. Section two of Mill Creek does not have a resident fish population at this time.

Overall, the proposed project area does provide both riparian and aquatic habitat. However, because of past development for private and commercial purposes, in many cases up to the streambank, we believe the overall values to be low. Mitigating aquatic habitat losses would be difficult if minimum streamflows cannot be guaranteed. If such flows could be established then fishery habitat improvements could be made. These would include: the placement of boulders in the creek, constructing pools, and planting of shrubs and trees to provide shading. The later would also provide streambank stabilization and wildlife habitat.

In summary, we believe that the project as presently poposed does not warrant our involvement in the scoping process. However, we do wish to be informed should changes be made in project plans.

We appreciate the opportunity to provide this information for use in your planning process.

Sincerely yours,

Field Supervisor
Ecological Services

cc: FWS/EC - Washington, DC
Corps of Engineers - Salt Lake City, Utah
Utah Division of Wildlife Resources - Salt Lake City, Utah

COPY

United States Department of the Interior
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
2060 ADMINISTRATION BUILDING
1745 WEST 1700 SOUTH
SALT LAKE CITY, UTAH 84104-5110

IN REPLY REFER TO:
(ES) July 15, 1985

Arthur E. Williams, Colonel, CE
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814

RE: SPKED-W, Upper Jordan River Interim Investigation, Salt Lake City, Utah

Dear Colonel Williams:

As per your request, we have reviewed the Draft Feasibility Report and Draft Environmental Impact Statement of June 1985. We note the project, as proposed in the Notice of Intent of September 6, 1984, has been reduced in size and scope to the point of only including two alternatives; Selected Plan, i.e. Hillview detention basin, and NO Action.

These comments are submitted under authority of the Fish and Wildlife Coordination Act (48 Stat. 401 as amended; 16 U.S.C. 661 et. seq.) and constitutes the report of U.S. Fish and Wildlife Service (FWS) on this project. In addition, these comments have been coordinated with the FWS Endangered Species Office (Salt Lake City) and the Utah Division of Wildlife Resources. Both offices concur with these findings. A copy of the Utah Division of Wildlife Resources letter is attached. Should changes be made in the project from those that are described in the June 1985 report and statement, the U.S. FWS and the Division of Wildlife Resources reserves the right to review and provide additional comments.

PLAN DESCRIPTION

The upper Mill Creek features include a diversion dam, located about 200 feet above Highland Drive, and a 7,440-foot-long, 90-inch-diameter pipeline connecting Mill Creek with the Hillview detention basin. The diversion dam is designed to bypass Mill Creek flows of up to 200 cfs to the channel and to divert up to 750 cfs into the pipeline for conveyance to the Hillview detention basin. The diversion dam incorporates a combination of sluice gates and a side overflow weir system. A side channel flume would direct the diverted flows into the pipeline. Flows would be regulated by a manually operated sluice gate. The diversion structure is capable of bypassing the 100-year flow to the channel below through two 7-foot-wide by 5-foot-high openings. Three auxillary 6-foot-wide bays are included with stoplogs. These bays would be used to augment the bypass of flows up to 1,500 cfs. Greater flow would overtop the structure.

The pipeline extending from the diversion structure to Hillview detention basin would be reinforced concrete. The alignment would largely follow streets and would be sited so as to have a minimum of 4 feet of overburden for crossover of water lines. The pipeline would have a drop in elevation of 99 feet over its course and a design velocity of 17 feet per second. Standard 36-inch manholes would be located every 500 feet for maintenance and access. The pipeline would outlet at an invert elevation of 4291.5 feet into the preproject Hillview detention basin which would have 73 acre-feet of capacity dedicated to Mill Creek diversions. Controlled releases from the basin would be made through a preproject conduit system into Big Cottonwood Creek.

EXISTING FISH AND WILDLIFE RESOURCES

Fish

Mill Creek. Mill Creek is 18.4 miles long with 10.7 miles on privately owned land and 7.7 miles of U.S. Forest Service (FS) land. For fishery management purposes, the Utah Division of Wildlife Resources (UDWR) has divided Mill Creek into four sections for description and classification. The project structures being considered for Mill Creek are all contained within the lower segment of section two.

Section two extends from Scott Avenue upstream to 2300 East; however, project related activities will end near Highland Drive. This reach flows through privately owned residential property and is bordered primarily by grasses and ornamental plants. Diversions in this section of Mill Creek cause complete dewatering during winter months and, thus, render this reach of the stream valueless as a fishery. Because of extensive dewatering, the UDWR has designated this reach as a Class VI (periodically dewatered) fishery; but believes that with a guaranteed minimum flow, a valuable trout fishery could be established.

Wildlife

Due to past and present development, terrestrial wildlife use is limited to those species of passerine birds, small mammals, amphibians and reptiles that are associated with an urban environment. In the immediate vicinity of the proposed diversion dam, riparian habitat is essentially nonexistent since adjacent lands have been developed as yard space by property owners.

Essentially, wildlife habitat is restricted to the detention basin area. This area is also surrounded by urban homes with the basin used as a seasonal pasture, thus limiting its value for wildlife. There are no known threatened or endangered species of flora or fauna within the project area of Mill Creek or the proposed detention basin.

FUTURE FISH AND WILDLIFE RESOURCES

Without-the-Project

In response to the 208 Water Quality Management Plan which provides for upgrading effluent from sewage treatment plants, water quality in the study area is expected to continue to improve. However, structural flood control facilities such as piecemeal channel improvements and discharge from storm drains are expected to have an adverse impact on the water quality. These changes in water quality are expected to have a minor impact on fishery resources in the project area. Furthermore, unless provisions for the maintenence of minimunm streamflows from upstream diversion areas are established, diversions will continue to limit the fishery potential in Mill Creek.

Terrestrial wildlife species will continue to be displaced as urban growth continues and human activity increases. As more habitat is lost to urbanizsttion, the limited riparian vegetation will become even more valuable for the various species of wildlife in the area adjacent to the project.

With-the-Project

Fish

The periodic filling and draining of the Hillview detention basin may cause the stranding of fish during the operation of this system. But as noted previously, fishery values are limited due to dewatering.

Wildlife

Periodic flooding and draining of the detention basin under consideration will result in a change of vegetation from that now present. Fluctuating water levels will displace upland vegetation and facilitate invasion of water tolerant species. Changes in vegetation species in the detention basin will lead to changes in the wildlife species utilizing the basin during times of the year when not flooded. Periodic flooding will destroy some small mammal populations in the basin and reduce habitat for small birds and other mobile species.

DISCUSSIONS

Overall, the proposed project area does provide limited riparian and aquatic habitat. However, because of past development for private purposes, in many cases up to the streambank, we believe the overall values to be low. Mitigating aquatic habitat losses would be difficult if minimum streamflows cannot be guaranteed.

If such flows could be established, then fishery habitat improvements could be made. These would include: the placement of boulders in the creek, constructing pools, and planting of shrubs and trees to provide shading. The later would also provide strambank stabilization and wildlife habitat.

In summary, we do not believe the project will cause significant impacts as presently proposed. However, we do wish to be informed should changes be made in project plans or the project expanded to include additional areas of Mill Creek.

Sincerely yours,

Robert L. McCue

Robert L. McCue
Field Supervsor

Attachment

cc: RO/HR - Denver, Colorado
UDWR - Salt Lake City, Utah
SE - Salt Lake City, Utah

BFreeman/vh

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
2060 ADMINISTRATION BUILDING
1745 WEST 1700 SOUTH
SALT LAKE CITY, UTAH 84104-5110

IN REPLY REFER TO:
(ES)

June 5, 1986

Wayne J. Scholl, Colonel CE
U.S. Army Corps of Engineers
Sacramento District
650 Capital Mall
Sacramento, California 95814
Attention: Matt Davis

RE: SPKED-W, Upper Jordan River Interim Investigation, Salt Lake City, Utah.

We have reviewed the proposed changes for the Upper Jordan River - Mill Creek Diversion project. Though the proposed changes would provide for an additional 73 acre feet of short-term storage capacity at the Hillview Detention Basin, we do not believe it would result in additional impacts other than what has already been discussed in previous reports.

We do request that disturbed and exposed soil areas be revegetated upon completion of the project. Since the detention pond will reduce downstream flood potential, we believe revegetation of the area with shurbs, trees, grasses and forbs would also aid in settling out soil fines transported by high stream flows. Revegetation would also aid in the re-establishment of songbirds and small mammals which will be displaced by the construction activity. We suggest that you refer to the guidelines that were developed by the Salt Lake County Flood Control and Water Quality Division for the Big Cottonwood Creek Project.

Aside from this concern, we have no other comments of offer.

Thank you for informing this office of the proposed project changes and allowing us to comment.

Sincerely yours,

Robert L. McCue
Field Supervisor

cc: RO(HR)-Den
EPA-Den
DWR-SLC

APPENDIX D

Letter dated 21 November 1984 from U.S. Soil Conservation Service

United States
Department of
Agriculture

Soil
Conservation
Service

P. O. Box 11350
Salt Lake City, UT 84147

November 21, 1984

George C. Weddell
Chief, Engineering Division
Department of the Army
Sacramento District, Corps of Engineers
650 Capital Mall
Sacramento, CA 95814-4794

Dear Mr. Weddell:

In response to your letter, October 11, 1984, requesting information regarding Important Farmland in Mill Creek, Utah, we have made a field review of the area.

The site in question (N 1/2 sec. 32, T. 1 S., R. 1 E.) is in an area of urban build up, which does not qualify as Prime, Unique or Important Farmland.

We are retaining the map you furnished and other associated data for future reference. Should you have other questions about the area please call on us.

Sincerely,

Richard L. Timmons, acting

FERRIS P. ALLGOOD
State Soil Scientist

cc:
James D. Maxwell, DC, SCS, Midvale, UT

The Soil Conservation Service
is an agency of the
Department of Agriculture

APPENDIX E

Letter dated 17 September 1986 from Division of State History on Cultural Resources Survey of The Hillview Detention Basin Area

NORMAN H. BANGERTER
GOVERNOR

STATE OF UTAH
DEPARTMENT OF COMMUNITY AND
ECONOMIC DEVELOPMENT

Division of
State History
(UTAH STATE HISTORICAL SOCIETY)

MELVIN T. SMITH, DIRECTOR
300 RIO GRANDE
SALT LAKE CITY, UTAH 84101-1182
TELEPHONE 801 / 533-5755

September 17, 1986

George C. Weddell
Chief, Engineering Division
Department of the Army
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

RE: SPKED-D, Cultural Resources Survey of the Hill Detention Basin Area, Salt Lake County, Utah

In Reply Please Refer to Case No. J251

Dear Mr. Weddell:

The Utah Preservation Office has received for consideration the above referenced project. After review of the report provided, our office has the following comments.

The report did not provide information about the nature of the project and what kind of earth disturbing activities will take place, or the extent of the disturbance. There was also no information on the type and possible depth of the soils in the project area. Based on the fact that there was 70% ground cover, and the recent discovery of a prehistoric Fremont site in downtown urban Salt Lake City, this office recommends that an archaeologist be present during initial earth disturbing activities to monitor the project for possible sub-surface cultural remains.

The above is provided on request as assistance as outlined by 36 CFR 800.5 or Utah Code, Title 63-18-37. If you have questions or need additional assistance, please contact either myself or Charles Shepherd at 533-7039.

Sincerely,

James

James L. Dykman
Acting Preservation Development Coordinator

LAD:jrc:J251/3365V

APPENDIX F

Mailing List

List of Agencies, Organizations, and Individuals to Whom Notices of Availability Were Sent

MAILING LIST

STATE AND GOVERNMENT OFFICIALS

United States Senators (2)1/
Representatives in Congress (2)
Utah State Senators (2)
Utah House of Representatives (4)

US GOVERNMENT DEPARTMENTS AND AGENCIES

Department of the Army (20)
Department of Agriculture (5)
Department of Commerce (6)
Department of Energy (10)
Federal Emergency Management Agency (2)
Department of Health & Human Services (3)
Department of Housing & Urban Development (3)
Department of the Interior (22)
Environmental Protection Agency (10)
Department of Transportation (3)
Advisory Council on Historic Preservation

UTAH STATE OFFICIALS AND AGENCIES

Governor of Utah
State Engineer, Div. of Water Rights
Division of State Lands
Division of Parks & Recreation
State Planning Coordinator
Bureau of Water Pollution Control
Commissioner, Department of Agriculture Department of Health
State Historic Preservation Officer
Department of Natural Resources and Energy
Division of Water Resources
Utah State Wildlife Resources Division
Utah Department of Transportation
Utah State Clearing House
Department of Development Services
Office of Emergency Services

SALT LAKE COUNTY OFFICIALS AND AGENCIES

Salt Lake County Public Works Department Salt Lake County Public Works
Board of Salt Lake County Commissioners
Parks & Recreation Department

MUNICIPAL OFFICIALS AND AGENCIES

Mayor of Salt Lake City
Salt Lake City Planning and Zoning Commission
City Engineer, Salt Lake City
Salt Lake City Parks Superintendent

Notes:

1/ The number in parenthesis refers to the number of notices (>1) that were sent.

BOARD OF PROVO-JORDAN RIVER PARKWAY AUTHORITY

LIBRARIES

University of Utah, Marriott Library
Salt Lake City Library

INTERESTED ORGANIZATIONS

Salt Lake County Council of Governments
Izaak Walton League of America
Council on Utah Resources
Sierra Club
Trout Unlimited
Utah Nature Study Society
Utah Environmental Center
Wasatch Mountain Club
National Wildlife Federation
Intermountain Water Alliance

INTERESTED INDIVIDUALS

Rick Van Wagenen
Dr. Alton B. Davis
Mr. John Talmage
Mr. Jim Byrne
Harold B. Lamb, M.D.

APPENDIX A

PERTINENT CORRESPONDENCE

SALT LAKE COUNTY PUBLIC WORKS DEPARTMENT
FLOOD CONTROL & HIGHWAY DIVISIONS
2001 S State St #N3300
Salt Lake City, UT 84190-4600
Phone 468-2711

COMMISSIONER
DAVE WATSON
DIRECTOR OF PUBLIC WORKS
JOHN D. HISKEY
DIVISION DIRECTOR
TOSHIHARU KANO, P.E.
TRANSPORTATION ENGINEER

Engineering Manager
Dave R. Lovell, P.E.

Field Services Manager
Neil D. Stack, P.E.

August 10, 1987

Colonel Wayne J. Scholl
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento California 95814-4794

Dear Colonel Scholl:

SUBJECT: Letter of Intent - upper Jordan River Interim Draft Feasibility Report and Draft Environmental Statement for the Upper Jordan River Interim Investigation, Dated April 1987.

We have reviewed the Draft Feasibility Report and Draft Environmental Statement and Salt Lake County is willing and able to accept the following responsibilities, which are presented in the report and summarized below:

a. Provide 5 percent of the cost of the project assigned to Flood Control during the construction of the project, currently estimated to be approximately $370,000.

b. Provide without cost to the United States all lands, easements, rights-of-way including borrow areas and disposal areas for excavated material determined suitable by the Chief of Engineers and necessary for construction, operation, and maintenance of the project, currently estimated to cost $490,000.

c. Hold and save the United States free from damages due to construction and subsequent operation and maintenance of the project, except for damages due to the fault of negligence of the United States or its contractors.

d. Operate and maintain without cost to the United States all project works after completion in accordance with regulations prescribed by the Secretary of the Army at an estimated annual cost of $20,000.

e. Accomplish without cost to the United States all alterations and relocations of transportation facilities, storm drains, utilities, and other structures and improvements made necessary by the construction of the project, at an estimated cost of $1,670,000.

f. Prior to initiation of construction, prescribe and enforce regulations to prevent obstruction of encroachment which would reduce Mill Creek's flood-carrying capacity or hinder maintenance and operation, and control development in the project area to prevent undue increases in the flood damage potential.

g. Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

h. Comply with the applicable requirements of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970" (PL 91-646).

i. Make all necessary improvements to the I-9 storm drainage system to accommodate the proposed Federal Plan of improvement. This may include construction of or contribution toward the construction cost of 26 acre-feet of storage at the Hillview site and an upper detention basin near 1500 East 4500 South.

In providing this Letter of Intent, it it mutually understood that our share of the local financial responsibility will not be committed until Congress appropriates funds for construction of the project. Also, Salt Lake County cannot consider funding until at least 1991 and that funding is contingent upon approval by the Salt Lake County Commission.

We look forward to working with the Corps in completion of this flood control project.

Sincerely,

TOSHIHARU KANO, P.E., Director
Flood Control and Highway Division

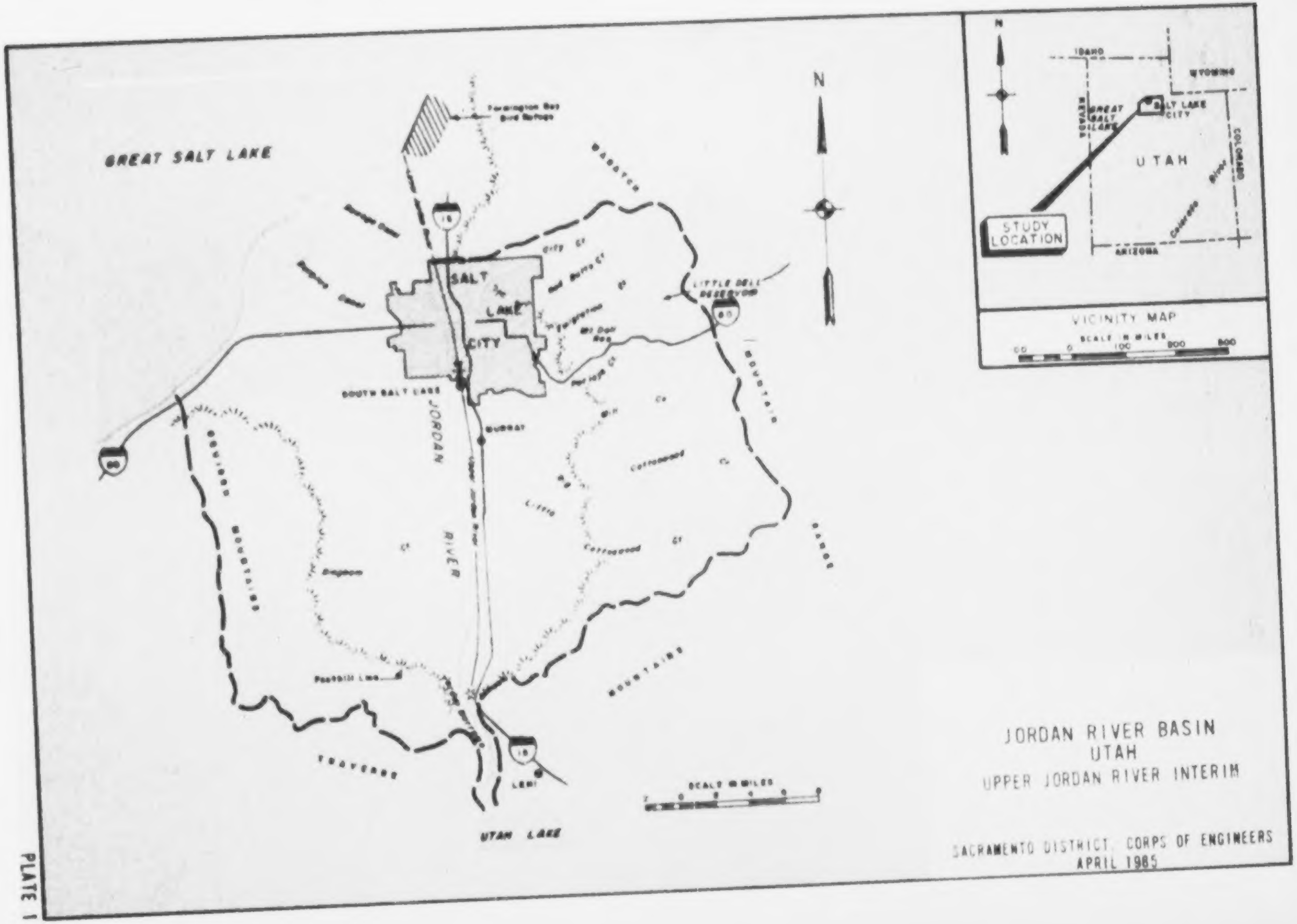
JOHN D. HISKEY, Director
Public Works Department

LARRY E. HOLLER
Administrative Officer

JDH/DRL/cb

cc: Dave Lovell

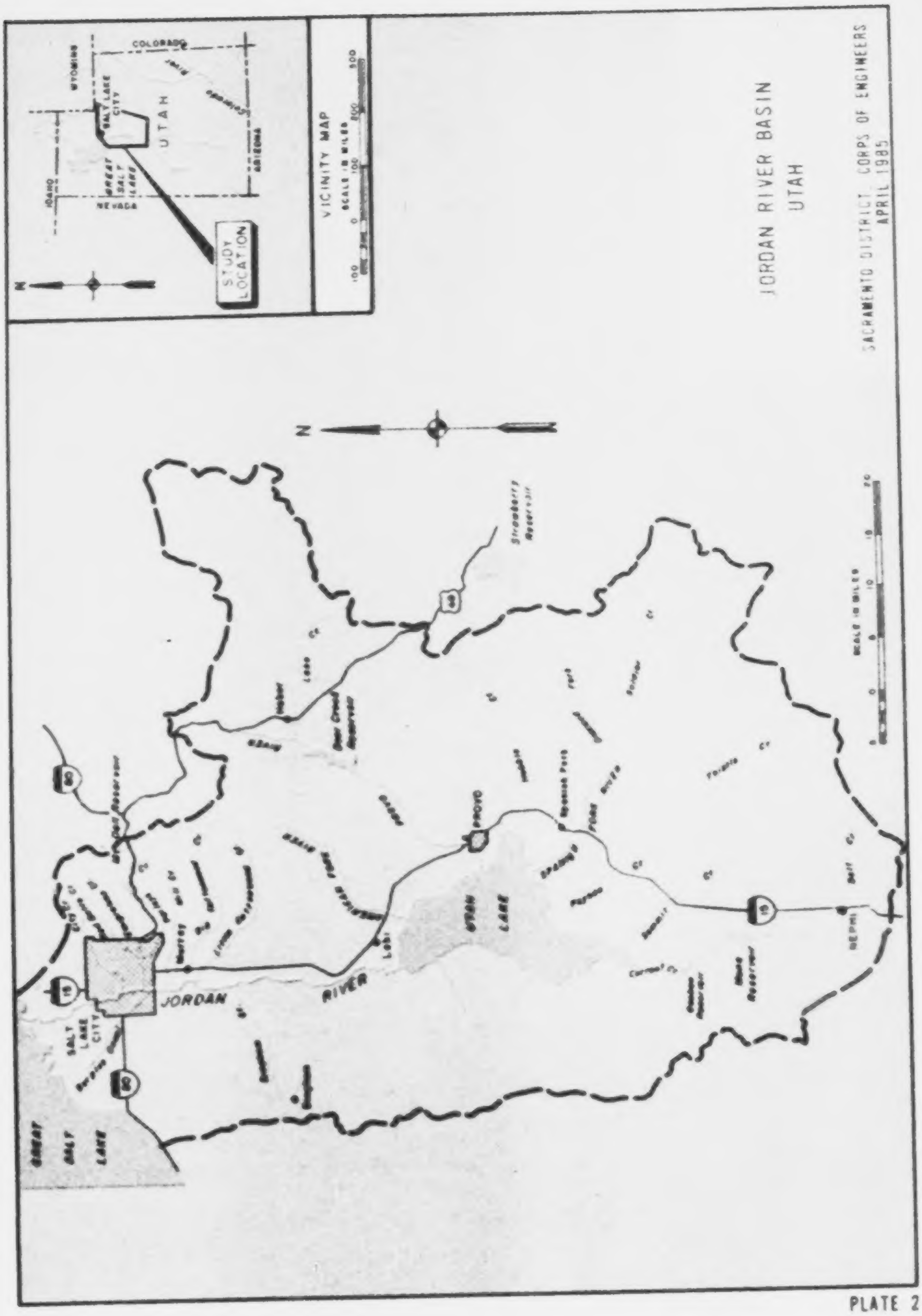
1100.30



JORDAN RIVER BASIN
UTAH
UPPER JORDAN RIVER INTERIM

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985

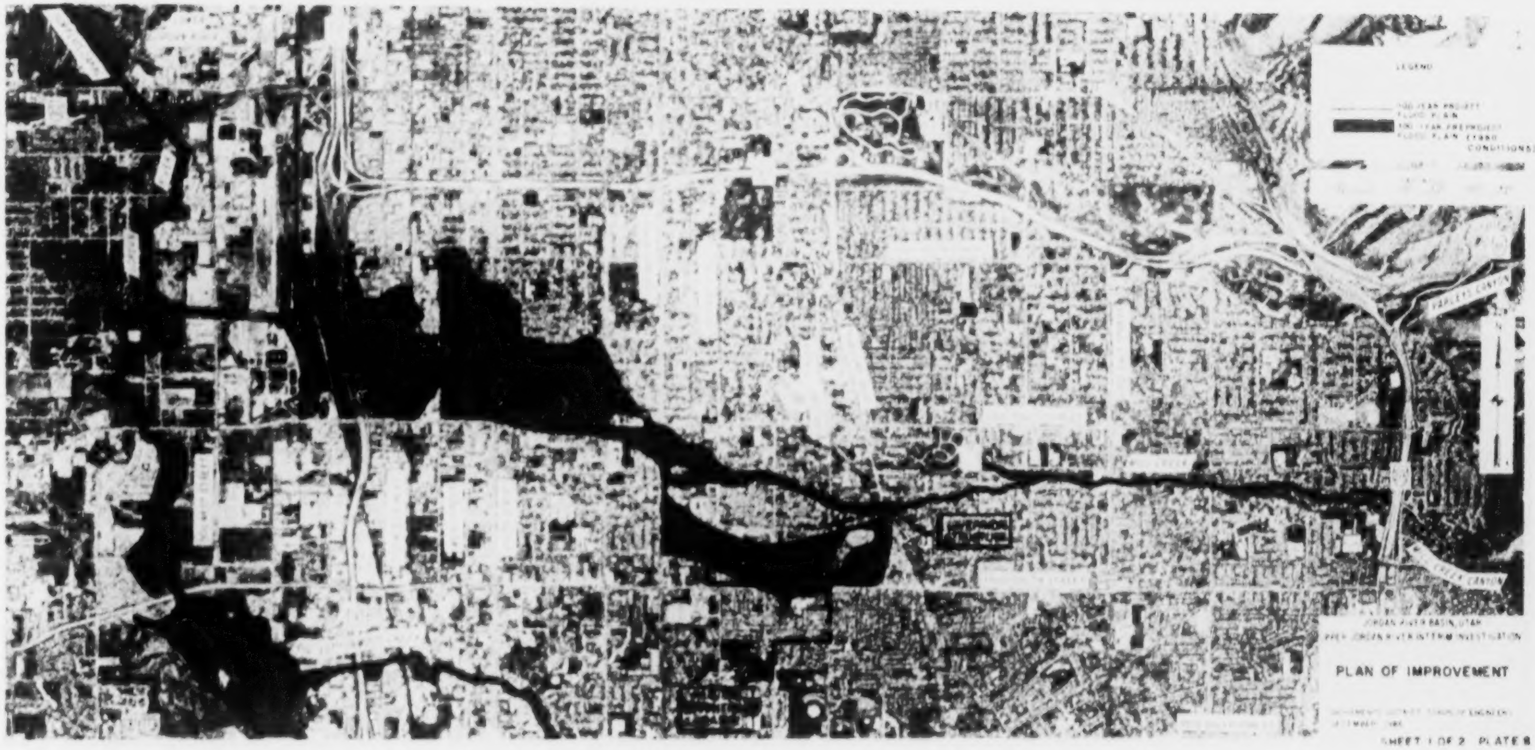
PLATE 1

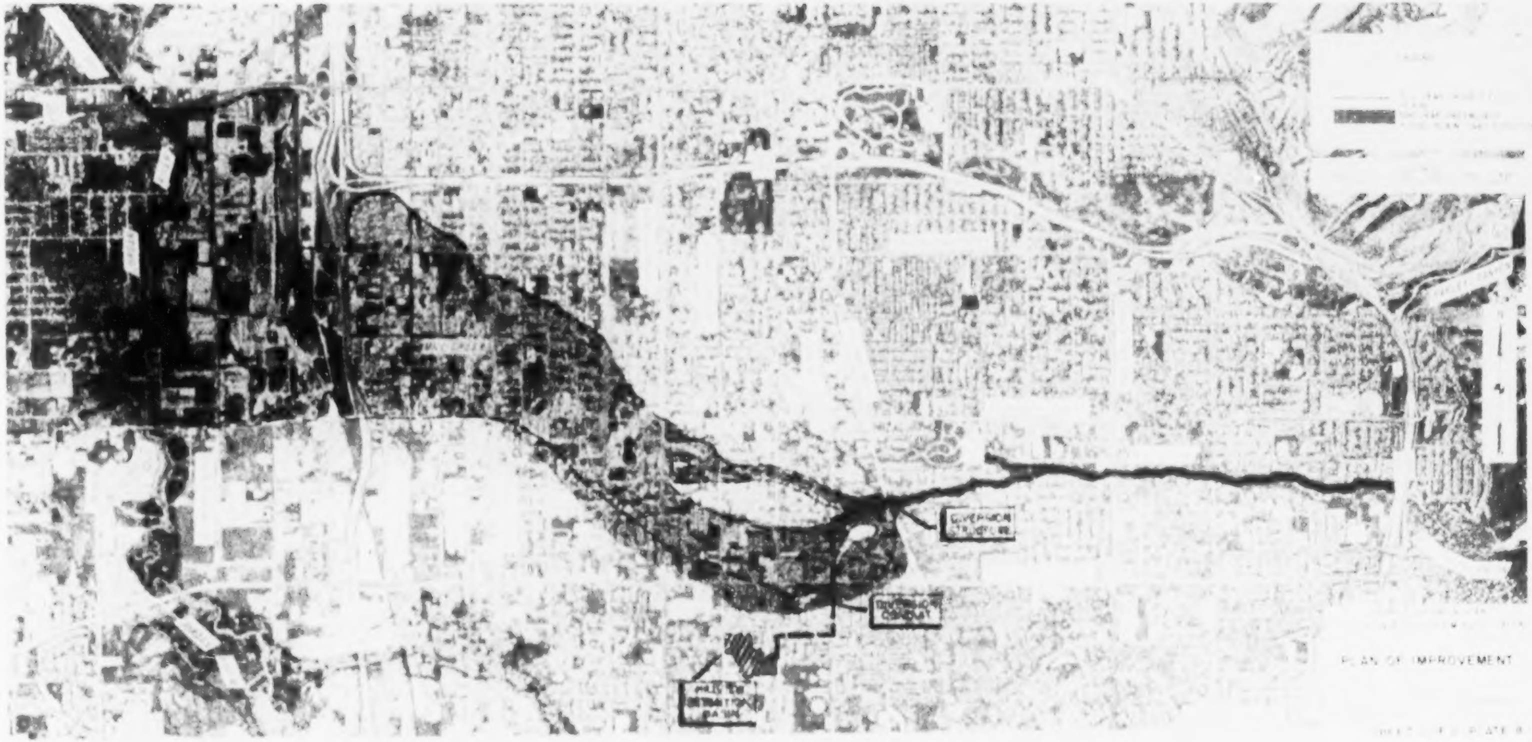


JORDAN RIVER BASIN
UTAH

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
APRIL 1985

PLATE 2


LEGEND
100 YEAR PROJECT FLOOD PLAIN
100 YEAR PREPROJECT FLOOD PLAIN (1980 CONDITIONS)
PARLEYS CANYON
CREEK CANYON
JORDAN RIVER BASIN, UTAH
UPPER JORDAN RIVER INTERIM INVESTIGATION
PLAN OF IMPROVEMENT
SHEET 1 OF 2 PLATE 8



DIVERSION STRUCTURE
DIVERSION CONDUIT
PLAN OF IMPROVEMENT